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NEW NUCLEAR DATA

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NEW NUCLEAR DATA

1. Radioactivity, Levels, Abundances, Moments
2. Neutron Cross Sections
3. Ground State Q's
4. Mass Differences and Ratios

INTRODUCTION

The nuclear data presented here have been compiled by the Nuclear Data Group which is sponsored by the National Research Council and supported by the Atomic Energy Commission and the National Bureau of Standards.

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This issue of Nuclear Science Abstracts contains the first 1954 quarterly list of new nuclear data. Additional quarterly summaries will follow in issues 12B, 18B, and 24B. Each quarterly will be a cumulation for 1954, that is it will contain the new quarter's material and all previous 1954 quarters' data.

As the current literature is surveyed, the new nuclear results are first printed on 3″ × 5″ cards which are collected into sets of 100 to 150 cards each month. Individuals, laboratories, or libraries may subscribe to the card sets directly by applying to the Nuclear Data Group, National Research Council, 2101 Constitution Avenue, N. W., Washington 25, D. C. The price, based on actual mechanical costs is currently $20 per year domestic and $30 per year foreign (air mail postage included for foreign but not for domestic subscriptions).

CONVENTIONS

All energies are given in Mev and all cross sections in barns unless otherwise stated in the tabular material.

Numerals in italics following a measured value are the error (as reported by the authors) in the last figures of the values. In cases where confusion seems possible, the conventional ± is used.

Magnetic moments are reported as before without diamagnetic correction but are now based on $\mu(H) = 2.79267$ and the substandards listed by H. Walchli, ORNL-1469.

In writing reactions in Table 1, Radioactivity, Levels, Abundances, Moments, superscripts to denote the A value of the target nucleus have been used only when the target material is monoisotopic or has been isotopically enriched. "B^{10}(d,p)," for example, means that the d,p reaction was observed in a sample enriched in B^{10} while "B(d,p)" means it was observed in natural B. This policy was followed previously for "heavy" but not for "light" nuclei. It was not practical to adhere to it in Table 3, Ground State Q's. In this table enrichment is denoted by underlining the A superscript.

When a method of production of a radioactive nucleus has been given, the lowest bombarding energy used by the experimenter is indicated; e.g. Ag(20-Mev p). If this energy has actually been determined to be the threshold, it is underlined, e.g. Sn(14-Mev p).

Even when unenriched material is not used, the nucleus under which the information is listed, is often fairly certain because of some large natural abundance or cross section, or because the particular activity produced or energy released. In such cases the nucleus in question is put down without following "?." When there is no indication as to the isotope involved, information is listed under the element in question.

The large black dots on the decay schemes are used to indicate experimentally established coincidences. α, β, or γ-rays entering a level and dotted at their arrowheads have been shown to be in coincidence with gamma-rays leaving the same level and dotted at their origins. In case of a simple cascade the dots of the incoming and outgoing rays are superimposed.

Electron capture, ϵ, is shown on decay schemes by long and short dashes. Dashes of equal length are used for doubtful radiations or levels.

ABBREVIATIONS

a	absorption measurement
a$\beta\gamma$	absorption of β's in coincidence with γ's
ace$^-$	absorption of conversion electrons
a coin	measurement by placing absorbers between counters in coincidence
α	total γ-ray conversion coefficient, N_e/N_γ
$\alpha_K,\alpha_L,\ldots$	γ-ray conversion coefficient for electrons ejected from the K,L, ... shell
$\alpha_0,\alpha_1,\ldots$	α to g.s., first excited state, ... of residual nucleus
b	coefficient in angular correlation function, $1 + b \cos^2 \theta$
B	band spectra method
Beγn	measurement by detection of photoneutrons from Be
B_n, B_p	Binding energy of a neutron, proton to a nucleus
$\beta\gamma(\theta)$	angular correlation of β's and γ's in coincidence
Calc	calculated value from experimental work reported elsewhere
cc	cloud chamber
CcW	Cockcroft Walton accelerator
ce$^-$	conversion electrons
chem	chemical separation of product following reaction
Cpt	Compton electrons
d	(1) deuteron, (2) descendant of, (3) days, when used as superscript
d,p(θ)	angular distribution of protons with respect to deuteron beam
Dγn,Dγp	measurement by detection of photoneutrons or photoprotons from deuterium
$\bar{E}$	average energy
E_0	resonance energy
$E_\beta, E_\gamma, \ldots$	energy of β ray, energy of γ ray, ...
E_{dis}	disintegration energy
EA	electrostatic analyzer
E1,E2, ...	electric dipole, electric quadrupole, ...
ϵ_A	Auger electron
el	elastic scattering
ϵ	electron capture
ϵ_K,ϵ_L	electron capture from K, L shell
f	fission, in abbreviations for methods of production or detection
F-K	Fermi-Kurie β energy distribution plot
$\gamma(\theta,T)$	numbers of γ's as function of angle and temperature
$\gamma\gamma,\beta\gamma, \alpha\gamma, n\gamma$	$\gamma\gamma,\beta\gamma$, $\alpha\gamma$, or nγ coincidences. (0.123 γ) (0.246 γ, 0.325 γ) means 0.123 γ in coincidence with 0.246 γ and 0.325 γ
Γ	resonance half-width (the whole width at half-maximum)
G-M	Geiger-Müller counter
g.s.	ground state
I	(1) nuclear induction magnetic resonance method; (2) spin in units $h/2\pi$. + or − signs after spin values denote even or odd parity of state in question
ic	ionization chamber
IT	isomeric transition
J	quantum state of compound nucleus in a nuclear reaction. "I" is used to denote the spin of the target nucleus, final nucleus
K/L	α_K/α_L
l	angular momentum of particle absorbed into nucleus
M	molecular or atomic beam resonance method
M1,M2, ...	magnetic dipole, magnetic quadrupole ...
mb	millibarns

Mic	microwave method
mir	measurement by total reflection of neutron beam from mirror surface
ms	mass spectrometer
μ	(1) magnetic moment in units of nuclear magnetons, (2) micron, 10^{-4} cm
μs	microseconds
osc	pile oscillator method
p	(1) proton, (2) predecessor of
p res	proton resonance. Magnetic field standardized by means of proton resonance frequency
para	paramagnetic resonance method
parentheses	parentheses are put around values which are given for identification purposes
pc	proportional counter
pe$^-$	photoelectrons
ppl	photoplates or emulsions
primes	primes indicate inelastically scattered particles
q	electric quadrupole moment in units of barns
quad res	quadrupole resonance method
Q	reaction energy in Mev
s	(1) spectrometer method, (2) seconds, when used as superscript
s pr	pair spectrometer
S	atomic spectra measurement
scin	scintillation counter
2 cryst scin s	2-crystal scintillation spectrometer
sl	lens spectrometer
sl ce$^-$	conversion electrons measured in lens spectrometer
st	strong
sπ	180° spectrometer
s$\pi\sqrt{2}$	double focusing spectrometer
σ	cross section in barns
σ_0	cross section at resonance energy, E_0
σ_a	absorption cross section
σ_{el}	elastic scattering cross section
σ_{in}	inelastic scattering cross section
σ_s	scattering cross section
σ_t	total cross section
t	(1) triton, H^3, (2) total cross section when used under σ in cross section list
T	(1) isotopic spin; (2) temperature
τ	half life in units indicated
τ_1, τ_2	half life of upper, lower state
$\tau_{\beta\beta}$, $\tau_{\epsilon\epsilon}$	half life for double β, double ϵ decay
th	thermal
VdG	Van de Graaff accelerator
w,vw	weak, very weak
%	% of disintegrations
†	relative numbers. When used in connection with γ rays, relative numbers of photons, not photons plus conversion electrons, are meant
+, −	even, odd parity when used in connection with level properties

Standard journal abbreviations are used.

1. RADIOACTIVITY, LEVELS, ABUNDANCES, MOMENTS

n^2
0 2
?

56^hNi^{66} not found by (n^2,p) when Cu exposed to possible n^2 from Bi(23-Mev p,n^2)

B.L.Cohen, T.H.Handley, Phys. Rev. 92,101, (1953).

H^2
1 1
stable

Capture γ H(n,γ) E_n= th scin
2.23
No other γ (E_γ = 0.02 to 3) (<5%)

B. Hamermesh, R.J.Culp, Phys. Rev. 92,211(1953).

H^3
1 2
12.4^y

β^- 0.0176 u
Neutrino mass (kev): <0.500 (Dirac)
< 0.250 (Majorana), < 0.150 (Fermi)

D.R.Hamilton, W.F.Alford, L.Gross, Phys. Rev. 92, 1521 (1953).

He^5
2 3
$\sim 10^{-21s}$

Levels $H^3(He^3,p)$ E_{He^3} = 0.30
g.s. p group observed at E_p= 9.33 scin
No group to first excited level observed

C.D.Moak, Phys. Rev. 92,383(1953); 91,462A(1953).

Li^6
3 3
stable

$|q|$ >0 Li^6Cl M
$q(Li^6)/q(Li^7)$ is positive

P. Kusch, Phys. Rev. 92, 268 (1953).

$|q(Li^6)/q(Li^7)|$ = 0.019 $LiAl(SiO_3)_2$ quad res

N.G.Cranna, Can. J. Phys. 31,1185 (1953).

Li^6 Level $He^4(d,d)$ $E_d = 1.0$ to 2.0
3 3 2.187 $J = 3+$ $\Gamma = 0.035$
stable σ and $d,d(\theta)$
No level between 2.2 and 3.2

T.Lauritsen, T.Huus, Phys. Rev. 92,1501(1953).

Li^7 q negative ?
3 4 Calculation takes into account quadrupole moment induced in s electrons by nuclear q
stable

R.M.Sternheimer, H.M.Foley, Phys. Rev. 92, 1460(1953); R.A.Logan, R.E.Coté, P.Kusch, Phys. Rev. 86, 280 (1952).

Levels $Li^6(d,p)$ $E_d = 8$
g.s. $l_n = 1$ $d,p(\theta)$
(0.478) $l_n = 1$

J.R.Holt, T.N.Marsham, Proc. Phys. Soc. 66A,1032 (1953).

Li^8 Level $Li^7(d,p)$ $E_d = 8$
3 5 8.3† g.s. $l_n = 1$ $d,p(\theta)$
0.9^s †mb/sterad at 0°

J.R.Holt, T.N.Marsham, Proc. Phys. Soc. 66A,1032 (1953).

Li^9 τ 0.168^s C($\leq$270-Mev γ)
3 6
0.17^s D.Reagan, Phys. Rev. 92, 651 (1953).

Be^8 Level $Be^9(d,t)$ $E_d = 1.16$
4 4 g.s. graph of $d,t(\theta)$ PPl
$\sim 10^{-16s}$

M.K.Juric, B.S.Marsicanin, Bull. Inst. Nuclear Sci., Boris Kidrich 3, 139 (1953).

Levels $B(p,\alpha)$ $E_p = 1.98, 2.61$
g.s.
2.9
No other levels found below 7 Mev (<10% g.s.)

R.Malm, D.R.Inglis, Phys. Rev. 92,1326(1953).

Levels $Li^7(p,\gamma)$ $E_p = 0.44$
2.0%* (4.09) α ranges
1.9% 5.31
0.5% 7.51
*α pairs per γ from 17.63 level $\alpha\gamma$

E.K.Inall, A.J.F.Boyle, Phil.Mag. 44, 1081(1953).

Levels $He(\alpha,\alpha)$ $E_\alpha = 12.9$ to 21.6
7.55 $J = 0$ $\Gamma = 1.2$
10.8 $J = 4$ $\Gamma = 1.2$
$\alpha,\alpha(\theta)$

F.E.Steigert, M.B.Sampson, Phys. Rev. 92,660(1953).

$p, \alpha(\theta)$ $Li(p,\alpha)$ $E_p = 0.61, 0.71, 0.80$
Coefficients of angular distribution given

D.K.Cartwright, L.L.Green, J.C.Willmott, Phil. Mag. 44, 1307 (1953).

Be^9 q ~ 0.02 Mic
4 5
stable W.D.Knight, Phys. Rev. 92,539A(1953).

Be^{10} Level $Be^9(d,p)$ $E_d = 8$
4 6 g.s. $l_n = 1$ $d,p(\theta)$
2.5×10^{6y}

J.R.Holt, T.N.Marsham, Proc. Phys. Soc. 66A,1032 (1953).

Level $Be^9(d,p)$ $E_d = 1.16$
g.s. graph of $d,p(\theta)$ PPl

M.K.Jurić, B.S.Marsicanin, Bull. Inst. Nuclear Sci., Boris Kidrich 3, 139 (1953).

B^{10} Level $Be^9(d,n)$ recoil
5 5 γ (0.72) $\tau = 7 \pm 2 \times 10^{-10s}$
stable

J.Thirion, V.L.Telegdi, Phys. Rev. 92,1253(1953).

Levels $Be^9(d,n)$ $E_d = 0.96$ PPl

		l_p	
	g.s.	1	$d,n(\theta)$
W	0.72	1	
	1.74	1	
	2.15	1	
	3.58	1	

Distributions show combination of stripping and compound nucleus formation

J.S.Pruitt, C.D.Swartz, S.S.Hanna, Phys. Rev. 92, 1456 (1953); 91, 463A (1953).

Levels $B^{10}(p,p')$ $E_p \sim 7$ $S\pi$
0.717 5
1.739 5
2.152 5
3.583 5
4.771 5
$B^{10}(d,d')$
1.74 level not observed

C.K.Bockelman, C.P.Browne, W.W.Buechner, A.Sperduto, Phys. Rev. 92, 665(1953); 90,340A(1953)

Capture γ's $Be^9(p,\gamma)$ scin

7.48 level $E_p = 0.993$ $\Gamma = 0.088$

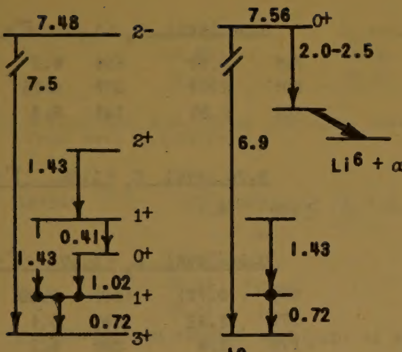
0.26†	0.41	~0.3†	1.43
2.3 †	0.72	18.9†	7.5
0.6 †	1.02		

7.56 level $E_p = 1.085$ $\Gamma \sim 0.004$

≤0.008†	(0.41)	~0.06†	1.43
1.1 †	0.72	~0.15†	2.0-2.5
≤0.04 †	(1.02)	1.0 †	6.9

†Thick target γ yield per 10^9 protons

B^{10}
5 5
stable



Stable B^{10}

W.F.Hornyak, T.Coor, Phys. Rev. 92,675(1953); 91,463A(1953).

B^{11}
5 6
stable

Q +0.0355 *2* M

G.Wessel, Phys. Rev. 92, 1581 (1953).

Level	B(d,p)		$E_d = 8$
	g.s.	$l_n = 1$	d,p(θ)

J.R.Holt, T.N.Marsham, Proc. Phys. Soc. 66A, 1032 (1953).

Levels	B^{10}(d,p)	$E_d = 8.06$ sπ
9†	7.99 *1*	Γ < 0.010 for
9†	8.57 *1*	first 5 levels
58†	8.93 *1*	
100†	9.19 *1*	
	9.28 *1*	
~60†	10.32 *2*	Γ = 0.054

† Rel. numbers of protons at 90°

M.M.Elkind, Phys. Rev. 92,127(1953); 91,463A(1953)

Levels	Be^9(d,n) Be^9(d,p)	$E_d = 0.96$
~16.7	J = 3/2 + } ?	d,n(θ)
~16.7	J = 5/2 − }	d,p(θ)

Strong cos θ terms superimposed on stripping patterns consistent with above spins

J.S.Pruitt, C.D.Swartz, S.S.Hanna, Phys. Rev. 92, 1456 (1953); 91, 463A (1953).

B^{12}
5 7
0.03^s

Levels	B^{11}(d,p)	$E_d = 8.06$ sπ
100†	g.s.	Γ < 0.010 for
78†	0.95 *1*	all levels
285†	1.67 *1*	
69†	2.62 *1*	
4†	2.72 *1*	
186†	3.38 *1*	

†Rel. numbers of protons at 90°

M.M.Elkind, Phys. Rev. 92,127(1953); 91,463A(1953)

B^{12}
5 7
0.03^s

Levels	B(d,p)	l_n	$E_d = 8$ d,p(θ)
7††	g.s.	1	
11†	(0.95)	1	
54†	(1.67)	0	
25†	(3.38)	1	
1††	(3.76)	1?	
29†	(4.53)	2	

†mb/sterad at 0° ††mb/sterad at 15°,35° resp.

J.R.Holt, T.N. Marsham, Proc. Phys. Soc. 66A 1032(1953).

B^{13}
5 8
?

τ $< 5 \times 10^{-4s}$ or $> 0.5^h$

No activity attributable to this nucleus found when various low and middle Z targets irradiated by 340-Mev p, 190-Mev d

E.L.Hubbard, L.Ruby, W.F.Stubbins, Phys. Rev. 92, 1494 (1953).

C^{11}
6 5
20.4^m

Resonances	B^{10}(p,γ)	$E_p = 0.5$ to 1.7
	0.78	broad
	0.95?	
	1.33?	

R.W.Krone, L.W.Seagondollar, Phys. Rev. 92, 935 (1953).

C^{12}
6 6
stable

Level	N(d,α)	$E_d = 0.62$
100†	(4.43)	
6†	7.68 *3*	Γ < 0.025 sπ/2

No other level below 9.2 Mev (< 1†)

D.N.F.Dunbar, R.E.Pixley, W.A.Wenzel, W.Whaling, Phys. Rev. 92, 649,1095A(1953).

C^{13}
6 7
stable

Levels	B^{10}(α,p) J	$E_\alpha = 1$ to 2 s α,p(θ)
g.s.	$1/2^-$	
3.13	$1/2^+$	
3.72	$3/2^-$	
3.86	$5/2^+$	

No 0.7 level (< 7% of g.s. protons)
0.21 γ observed, interperted as 30% branch from 3.9 to 3.7 level
Yield proton groups given for 7 α energies

E.S.Shire, J.R.Wormald, G.Lindsay-Jones, A.Lundén, A.G.Stanley, Phil. Mag. 44, 1197(1953).

Level	C(n,n)	$E_n = 2.08$, scin
	(6.87) $J = 3/2^+, 5/2^+$	n,n(θ)

R.Ricamo, Nuovo Cim. 10, 1607(1953).

	B(α,p)	$E_\alpha = 5.3$
No 0.7 level		apy

J.Thirion, Ann. Phys. 8, 489 (1953).

C^{13}
6 7
stable

γ's C(d,pγ) $E_d = 2.4$

	0.168	sl pe⁻
45†	(3.08)	sl Cpt
5†	3.67	
4†	3.83	

R.J.Mackin, Jr., Phys. Rev. 92, 529A(1953).

C^{14}
6 8
~5600ʸ

Level C(d,p) $E_d = 0.28$ to 0.64
g.s. $l_n = 1$ d,p(θ)
Reaction proceeds mainly by stripping

B.Koudijs, F.P.G.Valckx, P.M.Endt, Physica 19, 1133 (1953).

N^{13}
7 6
10.1ᵐ

Levels C(p,p) $E_p = 2$ to 7
~4.9 a
~6.4
C(p,p'γ) $E_p = 2$ to 7
6.90 a
7.40

M.Martin, H.Schneider, N.Sempert, Helv. Phys. Acta 26, 595A(1953).

N^{14}
7 7
stable

Levels O(d,α) $E_d = 19$ ppl

2.6†	g.s.
<0.1†	(2.31)

†Total σ in mb

R.G.Freemantle, W.M.Gibson, D.J.Prowse, J.Rotblat, Phys. Rev. 92, 1268(1953).

Levels N(p,p') $E_p \sim 7$ sπ
2.313 *5*
3.945 *6*
4.91 *1*
5.10 *1*
N(d,d')
2.31 level not observed

C.K.Bockelman, C.P.Browne, W.W.Buechner, A.Sperduto Phys. Rev. 92,665(1953); 90,340A(1953).

Capture γ's $C^{13}(p,\gamma)$ scin
8.06 level $E_p = 0.55$ T = 1 > 98%

2.307	<0.7†	(5.70)
4.11	100†	8.06

A.B.Clegg, D.H.Wilkinson, Phil. Mag. 44,1269, (1953).

γ's $C^{13}(d,n\gamma)$ scin
5.69 level (3.38γ) (2.31γ)
5.81 level (0.73γ) (4.5-5.2γ)

Capture γ's $C^{13}(p,\gamma)$ scin
8.06 level $E_p = 0.55$ Γ = 0.033

7.3†	1.63	15†	4.0
7.3†	2.32	69†	8.0

N^{14}
7 7
stable

8.62 level $E_p = 1.16$ Γ = 0.006

39†	1.64	59†	4.7
66†	2.33	27†	6.25
20†	3.94	14†	8.6

8.70 level $E_p = 1.25$ Γ = 0.5
≥ 90† 8.7

8.90 level $E_p = 1.47$ Γ = 0.02

65†	0.731	100†	3.09
17†	2.32	48†	5.1
17†	2.8	35†	5.7

8.98 level $E_p = 1.55$ Γ = 0.007
≥ 85† 9.0

9.17 level $E_p = 1.76$ Γ = 0.0021

10†	2.73	90†	9.2
10†	6.5		

9.49 level $E_p = 2.10$ Γ = 0.045

26†	2.32	100†	4.41
26†	2.78	74†	5.09

H.H.Woodbury, R.B.Day, A.V.Tollestrup, Phys. Rev. 92, 1199 (1953).

Levels	$B^{10}(\alpha,p)$ J	$B^{10}(\alpha,d)$ Γ
12.42	4⁻	0.043
12.50		0.036
12.61		0.050
12.69	3⁻	0.014*
12.78	4+	0.014*
12.81	4⁻	0.006
12.92	4+	0.021

No capture γ's scin
Yield p and α groups given for 7 α energies
*All partial Γ's also given $E_\alpha = 1$ to 2

E.S.Shire, J.R.Wormald, G.Kindsay-Jones, A.Lundén, A.G.Stanley, Phil. Mag. 44, 1197 (1953).

N^{15}
7 8
stable

Levels N(n,p)		N(n,α)	
11.26	12.37	11.91	13.21
11.41	12.46	11.99	13.49
11.78	12.65	12.10	13.61
11.91	12.90	12.17	13.74
12.02	13.01	12.39	13.85
12.12		12.49	13.95
		12.63	14.01
		12.86	14.14
		12.96	

RaBe n ic

G. von Gierke, Z.Naturf. 8a, 567 (1953).

$O^{18}(p,\alpha)$ $E_p = 0.4$ to 0.7
No γ scin

R.R.Roy, A.Lagasse, M.J.Decock, Phil. Mag. 44, 1189 (1953).

O^{16}
8 8
stable

Levels $O(p,p')$ $E_p = 9.5$ ppl
(6.05) (6.9)
(6.13) (7.1)

W.E.Burcham, W.M.Gibson, A.Hossain, J.Rotblat, Phys. Rev. 92,1266(1953).

Levels $F^{19}(p,\alpha\gamma)$ $E_p = 0.87$
$\underline{J}$
(6.13) 3−
(6.9) 2^+
(7.1) 1^-
γ polarization studied by $D(\gamma,p)$ at 90°

L.W.Fagg, S.S.Hanna, Phys. Rev. 92,372(1953); 88, 1205(1952).

Levels $N^{15}(p,\alpha)$ $E_p = 0.23$ to 0.96
12.43 $J = 0^+$ $p,\alpha_0(\theta)$
13.09 $J = 1^-$

A.V.Cohen, A.P.French, Phil. Mag. 44, 1259(1953)

O^{17}
8 9
stable

Levels $O(d,p)$ $E_d = 19$ ppl
36† g.s. $l_n = 2$ $d,p(\theta)$
23† (0.88) $l_n = 0$
†Total σ in mb

R.G.Freemantle, W.M.Gibson, D.J.Prowse, J.Rotblat, Phys. Rev. 92,1268(1953).

Level $N(\alpha,p)$ $E_\alpha = 5.30$ ppl
0.86

E.Hjalmar, H.Slätis, Arkiv Fysik 6,451(1953).

Level $O(d,n)$ recoil
(0.87) $\tau = 2.5 \pm 1.0 \times 10^{-10}$s

J.Thirion, V.L.Telegdi, Phys. Rev. 92,1253(1953).

Levels $O(n,n)$ $E_n = 0.39$ to 1.4
4.56 $J = 3/2-$ $n,n(\theta)$
5.08 $J = 3/2+$ O recoil
5.39 $J = 3/2-$

R.K.Adair, Phys. Rev. 92, 1491 (1953).

Levels $C(\alpha,n)$ $E_\alpha = 0$ to 2
7.158 *9* $\Gamma \sim 0.003$ scin
7.372 *11*

G.A.Jones, D.H.Wilkinson, Proc. Rhys. Soc. 66A, 1176 (1953).

Levels $O(n,\alpha)$
6.55 7.28
6.79 7.43
6.96 7.63
7.11
Li(d,n) lc

K.Kimura, R.Ishiwari, M.Sakisaka, I.Kumabe, S.Yamashita, K.Miyake, Bull. Inst. Research, Kyoto. Univ. 31,204(1953); Chem. Abstr. 47-10358g(1953).

O^{17}
8 9
stable

Levels $O(n,\alpha)$

6.83	7.85	9.76	11.36
6.89	7.98?	10.07	11.49
6.99	8.23	10.25?	11.61?
7.11	8.62	10.39	11.84
7.35	8.84	10.57	12.03
7.48	9.09	10.85	12.25
7.63	9.34	11.07?	12.47
7.71	9.57?	11.17	12.73?

RaBe n lc

G. von Gierke, Z. Naturf. 8a, 567 (1953).

F^{17}
9 8
70^s

β^+ 1.749 sl
No 0.88 β^+ (< 1%) No γ

C.Wong, Phys. Rev. 92, 529A(1953).

F^{18}
9 9
1.87^h

Levels $N(\alpha,p)O$ $E_\alpha = 1.5$ to 3.5
$\underline{\Gamma}$
0.3† 6.694 0.027 pc
5† 6.854 0.093
~7.1 ~0.46
$\alpha\alpha$ elastic resonances consistent with above levels
†Percent of elastic scattering

N.P.Heydenburg, G.M.Temmer, Phys. Rev. 92,89(1953)

F^{19}
9 10
stable

Levels $O^{18}(d,n)$ $E_d = 2$ ppl
0.2 3.85
0.9 4.5
1.4 4.8
1.6 5.2
2.2 5.5
2.75

R.L.Seale, Phys. Rev. 92, 389 (1953).

F^{20}
9 11
12^s

β^+ 5.42 F-K plot linear sl
γ 1.627

C.Wong, Phys. Rev. 92, 529A(1953).

Ne^{20}
10 10
stable

Levels $F^{19}(p,\alpha)$
13.44 $\Gamma_\gamma^* < 2$ ev scin
13.70 $\Gamma_\gamma^* < 15$ ev
*From intensity of Ne^{20} 12-Mev γ relative to O^{16} 6- and 7-Mev γ's

D.H.Wilkinson, A.B.Clegg, Phil. Mag. 44, 1322 (1953).

Levels $F^{19}(p,\alpha\gamma)$
(13.759) $J = 1+$ $p,6.14\gamma(\theta)$
(14.182) $J = 2-$ $p,6.9\gamma + 7.1\gamma(\theta)$
$(6.14\gamma)/(6.9\gamma + 7.1\gamma) = 8.7$ at 90° $E_p = 1.381$

J.E.Sanders, Phil. Mag. 44, 1302 (1953).

Na^{22}
11 11
2.6^y

ϵ_K 7 ± 2%

W.F.Hornyak, T.Coor, Phys. Rev. 92,675(1953).

Mg	γ	Mg(n,n'γ)	$E_n = 14$	scin
		1.4		n'γ

R.E.Garrett, F.L.Hereford, B.W.Sloope, Phys. Rev. 92, 1507 (1953); 91,441A (1953).

Mg^{24} 12 12 stable	Resonances	Na^{23} (p,γ)	
		0.3022 *6*	$\Gamma < 50$ ev
		0.5945 *15*	$\Gamma \sim 400$ ev

O.H.Turner, Australian J. Sci. Res. 6,380, (1953).

Capture γ's	Na^{23} (p,γ)		$E_p = 0.3022$	
~25†	0.41	4†	6.2	scin
≤30†	0.63	3†	6.8	
~50†	0.80	6†	7.2	
~70†	1.38	44†	7.73	
20†	2.86	~1†	8.5	
14†	3.43	13†	9.2	
18†	3.89	7†	9.9	
28†	4.30	13†	10.6	
~2†	5.3	4†	11.2	
~3†	5.8	23†	11.8	

$\gamma\gamma$ coincidences support decay scheme

O.H.Turner, Australian J. Sci. Res. 6,380, (1953).

Al^{27} 13 14 stable	γ's	Al^{27} (n,n'γ)	$E_n = 14$	scin
		0.82		n'γ
		1.02		
		2.34		

R.E.Garrett, F.L.Hereford, B.W.Sloope, Phys. Rev. 92, 1507 (1953); 91,441A (1953).

Si^{29} 14 15 stable	I	1/2	S

R.A.Ogg, Jr., J.D.Ray, J. Chem. Phys. 22, 147, (1954).

I	1/2	Mic
Q	$<1 \times 10^{-4}$	

R.L.White, C.H.Townes, Phys. Rev. 92,1256(1953)

P^{29} 15 14 4.6^s	β^+		3.945	Si(3-Mev d); sl
		~3%	~2.6	
	γ	1.5%	(1.28)	

H.Roderick, C.Wong, Phys. Rev. 92, 204(1953).

P^{30} 15 15 2.5^m	τ'	2.5^m	P(≤30-Mev γ)
	No γ		scin

No shorter lived activity observed

P.Stähelin, Helv. Phys. Acta 26,691(1953).

P^{31} 15 16 stable	Resonances	Al^{27} (α,p)Si		
		(4.0)	$\Gamma = 0.36$	cc
		(4.4)	$\Gamma = 0.30$	

R.R.Roy, C.Godeau, Phil. Mag. 44,1184(1953).

S^{33} 16 17 stable	Level	A^{36} (n,α)	$E_n = 2.15$ to 4.40	
		0.9		pc

(Incorrectly given as 1.1 in NSA 7)

B.J.Toppel, S.D.Bloom, Phys. Rev. 91,473A(1953).

S^{35} 16 19 87^d

No β^-'s with $E_\beta < 10$ kev found from $C_2H_5S^{35}H$ in cc

G.J.Plain, H.L.Morrison, P.H.Pitkanen, F.T. Rogers, Jr., Phys. Rev. 92,529A(1953).

Cl^{34} 17 17 1.5^s	τ_2	1.58^s	d 33^mCl	chem

W.Arber, P.Stähelin, Helv. Phys. Acta 26,584A,691 (1953); Phys. Rev. 92, 1076(1953).

A^{38} 18 20 stable	Levels	Cl^{35} (α,p)	$E_\alpha = 7.45$	
		2.13		a
		3.73		

A.Z.Kranz, W.W.Watson, Phys. Rev. 91,1472(1953).

K^{38} 19 19 0.95^s	τ_2	0.95^s	K(≤31-Mev γ)
	β^+	(4.57)*	

$\sigma(0.95^sK)/\sigma(7.7^mK) = \sim 1$ $E_\gamma \leq 16$ to $E_\gamma \leq 31$

Suggest this is $J = 0^+$ and $T = 1$ state

*Formerly assigned to K^{37}

P.Stähelin, Helv. Phys. Acta 26,691(1953); Phys. Rev. 92,1076(1953).*F.I.Boley, D.J. Zaffarano, Phys. Rev. 84,1059(1951).

K^{42} 19 23 12.5^h

No (2.04 β) (1.51 γ) polarization-direction

D.R.Hamilton, A.Lemonick, F.M.Pipkin, Phys. Rev. 92. 1191(1953); 90, 370A(1953)

Ca^{47} 20 27 4.8^d	τ		5.4^d *1*	Ca^{46} (pile n)	chem
	β^-	60%	0.46		sm 2
		40%	1.40		
	γ		0.1495		sm ce_K^-
			0.234		ce_K^-
			0.495		ce^- pe^-
			0.80		pe^-
			1.30		pe^-

(> 0.6β)(~ 0.2γ)

J.M.Cork, J.M.LeBlanc, M.K.Brice, W.H.Nester, Phys. Rev. 92, 367 (1953).

τ		4.3^d *2*	Cr(420-Mev p)	chem
β^-	81%	0.685		sl
	19%	2.060	F-K plot linear	

L.Marquez, Phys. Rev. 92, 1511 (1953).

β^-	~80%	0.8	Ca(28-Mev d)	chem;	a
	~20%	2.0	Ti(28-Mev d)	chem	
γ		1.3			scin

A.H.W.Aten, Jr., E.Greuell, W.J.van Dijk, Physica 19, 1049 (1953).

Sc^{43}
21 22
4.0^h

γ 25† 0.375 scin
†Percent of β^+

R.H.Nussbaum, R. van Lieshout, A.H.Wapstra, Phys. Rev. 92, 207 (1953).

Sc^{47}
21 26
3.43^d

τ 3.44^d *5* d 4.8^dCa
β^- 28% 0.280 F-K plot linear sl
72% 0.490 F-K plot linear
γ ~0.22 sl ce^-

L.Marquez, Phys. Rev. 92, 1511 (1953).

τ 3.40^d *5* d 4.8^dCa
β^- 0.64 $s\pi$ $\sqrt{2}$
γ 0.1595 K/LM~10 $s\pi$ ce^-
$(0.64\beta)(0.16\gamma)$

J.M.Cork, J.M.LeBlanc, W.K.Brice, W.H.Nester, Phys. Rev. 92, 367 (1953).

Sc^{48}
21 27
1.83^d

γ 100† (0.98) Ti($\leq$ 18-Mev n) scin
100† 1.04 V^{48} comparison
100† (1.32)
$\gamma\gamma\gamma$

H.Casson, L.S.Goodman, V.E.Krohn, Phys. Rev. 92, 1517 (1953).

$(1.04\gamma)(0.98\gamma)(\theta)$ I = 6, 4, 2, 0

C.E.Whittle, P.S.Jastram, Phys. Rev. 92,205, (1953).

Ti^{45}
22 23
3.07^h

No 0.45γ (< 1.5% of β^+) scin, $\beta\gamma$

R.H.Nussbaum, R.van Lieshout, A.H.Wapstra, Phys. Rev. 92, 207(1953).

Ti^{47}
22 25
stable

I 5/2 $Ti^{47}Cl_4$ I
μ -0.7871^* *1*
*From $\nu(Ti^{47})/\nu(D) = 0.36721$ *6*
Also $\nu(Ti^{47})/\nu(Cl^{35}) = 0.57493$ *6*

C.D.Jeffries, Phys. Rev. 92,1262,1096A(1953).

Ti^{49}
22 27
stable

7/2 $Ti^{49}Cl_4$ I
μ -1.1023^* *2*
*From $\nu(Ti^{49})/\nu(D) = 0.36731$ *6*
Also $\nu(Ti^{49})/\nu(Cl^{35}) = 0.57508$ *6*

C.D.Jeffries, Phys. Rev. 92,1262,1096A(1953).

Ti^{51}
22 29
5.8^m

No 0.48γ (< 3% of 0.325γ) scin

R.H.Nussbaum, R. van Lieshout, A.H.Wapstra, Phys. Rev. 92, 207 (1953).

V^{47}
23 24
33^m

No γ (< 20%) Ti(26-Mev d) chem; a

A.H.W.Aten, Jr., J.Kool, B. de Vries, A.L. Veenendaal, Physica 19, 1051 (1953).

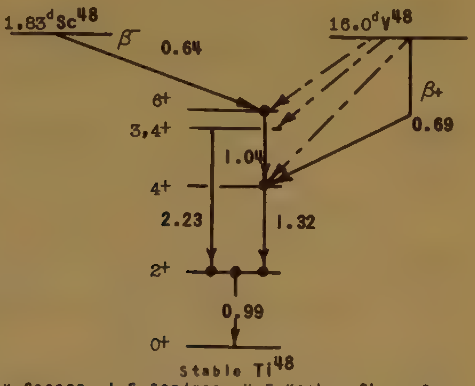
V^{48}
23 25
16.0^d

β^+ 0.692 Cr(420-Mev p) chem
No $0.82\beta^+$ (< 0.2%) sl
No > $0.87\beta^+$ (< 0.1%)

L.Marquez, Phys. Rev. 92, 1511 (1953).

V^{48}
23 25
16.0^d

$(2.2\gamma)(0.99\gamma)$ Cr(22-Mev d) chem scin
$\gamma\gamma\gamma$ in 10 ± 5 % of disintegrations
$\beta^+/(1.32\gamma) = 0.49 \pm 0.04$ assuming Na^{22} $\beta^+/\epsilon = 19$



H.Casson, L.S.Goodman, V.E.Krohn, Phys. Rev. 92,1517(1953).

V^{50}
23 27
$>10^{12y}$

I 6 para
$\mu(V^{50})/\mu(V^{51}) = 0.6501$ *14*

C.Kikuchi, M.H.Sirvetz, V.W.Cohen, Phys. Rev. 92, 109(1953); Phys. Rev. 88, 142 (1952).

V^{51}
23 28
stable

q ~0.3 S

K.Murakawa, T.Kamei, Phys. Rev. 92,325(1953).

V^{52}
23 29
2.6^m

Levels V(d,p) $E_d = 5.74$ $s\pi$

93†	g.s.		
36†	0.13	48†	2.13
7†	0.42	33†	2.15
50†	0.78	40†	2.31
75†	0.83	39†	2.42
21†	1.40	10†	2.46
13†	1.48	22†	2.53
100†	1.55	21†	2.85
50†	1.75	20†	3.00
38†	1.79	41†	[illegible].05
20†	1.84	52†	3.19
43†	2.09	29†	3.31

J.E.Schwager, L.A.Cox, Phys. Rev. 92,102(1953).

Cr

Neutron resonance (ev) $E_n = 3$ to 10^5 ev
3800 $\sigma_0\Gamma^2 = 8.55 \times 10^7$
time of flight

E.Melkonian, W.W.Havens, Jr., L.J.Rainwater, Phys. Rev. 92, 702 (1953).

Cr^{49}
24 25
41.8^m

β^+ 1.47 a
γ 5† 0.060 scin
18† 0.091
12† 0.151
5† 1.57
No 0.19 γ
†Percent of β^+

R.H.Nussbaum, R. van Lieshout, A.H.Wapstra, Phys. Rev. 92, 207 (1953).

Cr^{51} No 0.48γ ($<$3% of 0.325γ) scin
24 27
27^d

R.H.Nussbaum, R. van Lieshout, A.H.Wapstra, Phys. Rev. 92, 207 (1953).

Mn^{51} No γ ($<$20%) Cr(8-Mev d) chem; a
25 26
45^m

A.H.W.Aten, Jr., J.Kool, B. de Vries, A. L. Veenendaal, Physica 19, 1051 (1953).

Mn^{54} τ_a 324^d Fe^{54}(pile n) chem
25 29 γ 0.83
320^d

G.H.Stafford, L.H.Stein, Nature 172,1103(1953)

Mn^{55} Q ~0.4 S
25 30
stable K.Murakawa, T.Kamei, Phys. Rev. 92,325(1953).

Mn^{56} γ (1.8) M1 98% E2 2% $\gamma\gamma(\theta)$
25 31 (2.1) M1 92% E2 8%
2.58^h
(1.8γ)(0.85γ)(θ) I = 2, 2, 0
(2.1γ)(0.85γ)(θ) I = 2, 2, 0

F.R.Metzger, W.B.Todd, Phys. Rev. 92,904(1953)

(0.845γ)(1.81γ,2.13γ)
No (1.81γ)(2.13γ)

E.Germagnoli, A.Malvicini, L.Zappa, Nuovo Cim. 10, 1388 (1953).

Fe γ's Fe(n,n'γ) E_n = 14 scin
0.85 1.44 n'γ
1.29 2.10

R.E.Garrett, F.L.Hereford, B.W.Sloope, Phys. Rev. 92, 1507 (1953); 91, 441A (1953).

Fe^{53} γ 30† 0.370 scin
26 27 †Percent of β^+
9^m

R.H.Nussbaum, R. van Lieshout, A.H.Wapstra, Phys. Rev. 92, 2 07 (1953).

Fe^{59} τ 45.0^d 2 Fe(pile n) chem
26 33 Counted for 16 days differential ic
45^d

J.Toballem, J. phys. radium 14, 553 (1953).

Co^{59} Q 0.5 S
27 32
stable K.Murakawa, T.Kamei, Phys. Rev. 92,325(1953).

Co^{60} γ (1.33) $\tau < 7 \times 10^{-10s}$ $\gamma\gamma$
27 33
5.2^y S.Gorodetzky, A.Knipper, R.Armbruster, A. Gallmann, J. phys. radium 14, 550 (1953).

Ni^{63} β^- 0.062 $\Delta I = 2$, yes shape EA
28 35
61^y Y.Kobayashi, G.Miyamoto, S.Mori, J. Phys. Soc. Japan 8, 684 (1953).

Cu γ's Cu(n,n'γ) E_n = 14 scin
0.9 ? 1.53 n'γ
1.13 2.19

R.E.Garrett, F.L.Hereford, B.W.Sloope, Phys. Rev. 92, 1507 (1953); 91,441A (1953).

Cu^{63} Q -0.13 S
29 34
stable H.Kopfermann, A.Steudel, S.Wagner, W.Walcher, Nachr. Akad. Wiss. Göttingen, Math-physik. Kl IIa, No. 1 (1953).

Zn^{65} τ 245.0^d 8 Zn(pile n) chem
30 35 Counted for 60 days differential ic
245^d

J.Toballem, J. phys. radium 14, 553(1953).

β^+ 1.7% 0.325 FK plot linear to 0.05
γ 44.1% (1.11) $\alpha = 2.6 \times 10^{-4}$ E2 sl
K/LM $<$10
ϵ_{gs} 54.2%
e_A^- : β^+ : ce^- = 10,300 : 361 : 2.35

J.F.Perkins, S.K.Haynes, Phys. Rev. 92, 687, 1096A(1953).

β^+ 0.327 Cu(d,2n) chem; sl
γ (1.11) $\alpha = 1.8 \times 10^{-4}$
No 0.20γ ($< 3 \times 10^{-4}$)
$\gamma/\beta^+ = 28$ 7
$\epsilon_{g.s.}/\beta^+ = 34$ 7(calc) thus $\Delta L = 0$ transition

R.Bouchez, P.Hubert, N.Perrin, M.Sakai, J. phys. radium 14, 29A; 14,273(1953); Compt. rend. 236, 1249 (1953).

β^+ 0.320 S7
$\gamma/\beta^+ = 24$ Na^{22}comparison(ϵ = 10%) scin

T.Yuasa, Compt. rend. 237, 1077 (1953).

Ga Relative abundances Ga vapor ms

A	69	71
%	60.5	30.5

S.Antkiw, V.H.Dibeler, J. Chem. Phys. 21,1890 (1953).

Neutron resonances (ev) E_n = 0.8 to 10^5 ev
time of flight

	$\sigma_0\Gamma^2$
102	2,200
310	170,000
500?	
1000?	

E.Melkonian, W.W.Havens, Jr., L.J.Rainwater, Phys. Rev. 92, 702(1953).

Ga^{66}
31 35
9.4^{h}

γ	2†	0.83	22†	2.75	scin
	30†	1.04	2†	3.24	
	3†	1.37	3†	3.41	
		1.58 ?	2†	3.78	
	4†	1.93	2†	4.12	
	6†	2.18	5†	4.33	
	2†	2.40	2†	4.83	

(<0.5β) (1.04, 1.37, 2.18, 2.75, 3.24, 3.41 γ's)
(<0.5β) (2.40, 3.78γ's)?
(>1.0β) (1.04, 1.37, 2.40?, 2.75 γ's)
(>2.2γ) (1.04, 1.58 γ's)
†Photons per 100 disintegrations assuming 40% ϵ

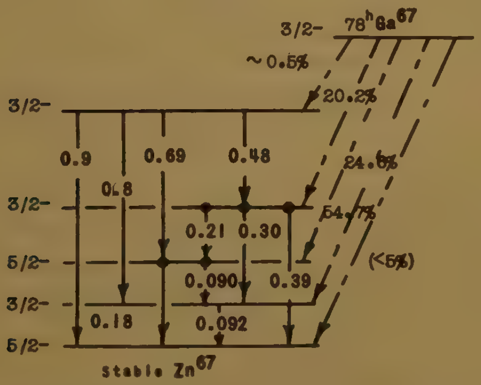
L.G.Mann, W.E.Meyerhoff, H.I.West, Jr., Phys. Rev. 92, 1481 (1953).

Ga^{67}
31 36
78^{h}

No β^{+} (< 0.01%)

γ	7†	0.090			scin
	93†	0.092	$\alpha = 0.54$	$\tau = 9.5^{\mu s}$	
	44†	0.182	~0.2†	0.48	
	3†	0.21	~0.1†	0.69	
	28†	0.30	~0.2†	~0.8	
	10†	0.39	~0.6†	~0.9	

(0.69γ) (0.18γ)   (0.21γ) (0.18γ)
(0.48γ) (0.39γ, 0.30γ, 0.18γ, 0.21γ)
0.09γ, 0.21γ, 0.30γ preceed 0.092γ
No γ follows 0.092γ
(0.21γ) (0.18γ) (θ)   I = 3/2, 5/2, 5/2



W.E.Meyerhof, L.G.Mann, H.I.West, Jr., Phys. Rev. 92, 758 (1953).

Ga^{69}
31 38
stable

q(Ga^{69})/q(Ga^{71}) = 1.5867 *4*   GaCl$_3$ quad res

H.G.Dehmelt, Phys. Rev. 92, 1240 (1953).

Ge^{73}
32 41
stable

μ	−0.8768 *1*	GeCl$_4$	I

ν(Ge^{73})/ν(D) = 0.22725 *3*

C.D.Jeffries, Phys. Rev. 92, 1262 (1953).

Ge^{67}
32 35
20^{m}

τ	19^{m}	Zn(52-Mev α) chem	
β^{+}	3.4		a
γ	0.17		scin

A.H.W.Aten, Jr., T. de Vries-Hamerling, L. Lindner, Physica 19, 1046 (1953).

As^{73}
33 40
76^{d}

γ (0.0135) $\alpha \geq 1300$ $\tau = 4.6^{\mu s}$
(0.0539) $\alpha = 4.7$ $\tau = 0.33^{s*}$
0.0135γ follows 0.054γ scin
No 0.081γ (< 0.2% of 0.054γ)   No 0.0674γ
All ϵ to 0.0674 level

J.P.Welker, A.W.Schardt, G.Friedlander, J.J. Howland, Jr., Phys. Rev. 92, 401 (1953); 91, 484A (1953). *E.C.Campbell, ibid.

γ (0.054) $\alpha \sim 8$ scin, pc

R.Barloutaud, R.Ballini, M.Sartori, Compt. rend. 237, 886 (1953).

As^{76}
33 43
26.5^{h}

τ		26.4^{h}	As(pile n) chem	
β^{-}	3%	0.35		sl
	6%	1.20		
	6%	1.75		
	32%	2.40		
	53%	2.96	$\Delta I = 2$, yes shape	
γ	100†	0.555		sl pe^{-}
	9†	0.648		
	23†	1.210		
	1.5†	1.410		
	5†	2.06		

P. Hubert, Ann. Phys. 8, 662 (1953).

γ (0.55)   E2
(2.41β) (0.55γ) polarization-direction

D.R.Hamilton, A.Lemonick, F.M.Pipkin, Phys. Rev. 92, 1191 (1953); 90, 370A (1953).

Capture γ's   As^{75}(n,γ)   s pr

2†	4.53	1†	6.05
1†	4.77	2†	6.38
1†	4.97	2†	6.85
2†	5.17	2†	7.05
1†	5.41	0.5†	7.30

Also graph E_{γ} = 2.5 to 8
†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025 (1953).

Se

Capture γ's   Se(n,γ)   s pr

2.0†	4.57	2.3†	6.02
0.7†	5.21	1.2†	6.23
2.1†	5.59	0.9†	6.41
1.4†	5.80		

Also graph E_{γ} = 3.5 to 10.6
See also Se^{77} and Se^{78}
†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

Se$^{73?}$
34 39
44^{m}

τ	44^{m}	Ge(52-Mev α) chem	
β^{+}	1.7		a

Not p 52^{m}As (< 0.1%)
σ(7^{h}Se)/σ(44^{m}Se) ~ 1 E_{α} = 33 to 52

F.N.Hooge, A.H.W.Aten, Jr., Physica 19, 1047 (1953).

Se^{77}
34 43
stable

Capture γ's Se(n,γ) s pr

3.6†	6.586
0.3†	6.88 ?
1.8†	7.185
2.2†	7.416

Above γ's fit Se^{77} levels known from Br^{77} decay. See also Se

†Photons per 100 n captures in Se

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051(1953).

Se^{78}
34 44
stable

Capture γ's Se(n,γ) s pr

0.7†	7.73	0.7†	9.172
0.1†	7.95	1.0†	9.882
0.5†	8.092	0.08†	10.483
0.2†	8.50		

>7.3 γ's assigned to Se^{78} from intensities and known mass ratio

†Photons per 100 n captures in Se

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051(1953).

Se^{79}
34 45
6.5×10^{4y}

I 7/2 Mic
μ -1.015
Q 0.7

W.A.Hardy, G.Silvey, C.H.Townes, B.F.Burke, M.W.P.Strandberg, G.W.Parker, V.W.Cohen, Phys. Rev. 92, 1532(1953); 85,494 (1952).

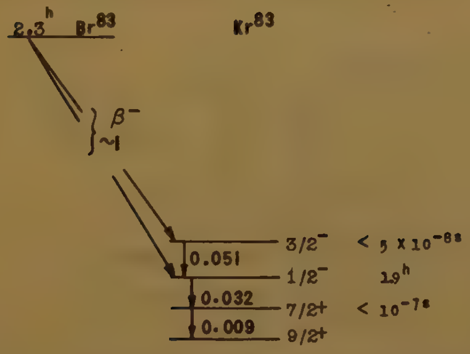
Br^{74}
35 39
36^{m}

τ 36^{m} Cu^{65}(90-Mev C) chem
Mass assignment based on yields in Cu^{65}(C,xn) and Cu^{63}(C,xn) reactions not p $7.1^{h}Se^{73}$

J.M.Hollander, Phys. Rev. 92, 518 (1953).

Br^{83}
35 48
2.3^{h}

τ 2.30^{h} 5 Se(10-Mev d) chem
γ 0.051 K/L$>$8 M1 aβe^-
$\tau < 5\times10^{-8s}$ $\beta\gamma$
$e^-/\beta = 0.12$ cc



P.Swinbank, J.Walker, Proc. Phys. Soc.66A, 1093 (1953).

Kr^{79}
36 43
34.5^{h}

γ (0.044) $\tau < 3^{\mu s}$ $e_A ce^-$ pc
$(ce^-\ 0.044\gamma)/(e_A(K)) \sim 0.007$
$e_A(L)/e_A(K) = 1.66$
$\epsilon_L/\epsilon_K = 0.10$ or 0.25 (0.10 theory) for fluorescence yield 0.63^* or 0.57^{**} resp.

M.Langevin, P.Radvanyi, Compt. rend. 238,77, 232(1954); *Broyles, Thomas, Haynes, Phys. Rev. 89,723(1953); **Burhop, The Auger Effect, Camb. Univ. Press p. 48(1952).

Kr^{85}
36 49
10.3^{y}

Levels Kr^{84}(d,p) $E_d = 3.80$ a

0.29	2.21*
1.60*	2.94*

*Or 1.18,1.79,2.52 levels in Kr^{87}

G.W.Wheeler, R.B.Schwartz, W.W.Watson, Phys. Rev. 92, 121 (1953).

Kr^{87}
36 51
78^{m}

Levels Kr^{86}(d,p) $E_d = 3.80$ a
0.52
1.17*
2.01*

*Or 1.59,2.43 Kr^{85} levels.

G.W.Wheeler, R.B.Schwartz, W.W.Watson, Phys. Rev. 92, 121 (1953).

Rb^{82}
37 45
1.25^{m}

τ_1 1.25^{m} d 26^{d}Sr chem
β^+ (3.15) a
No γ with $E_\gamma > 0.6$
Not p 6.3^{h}Rb ($<0.1\%$)

L.M.Litz, S.A.Ring, W.R.Balkwell, Phys. Rev. 92, 288 (1953).

Rb^{86}
37 49
19.5^{d}

γ (1.08) E2
$(0.72\beta)(1.08\gamma)$ polarization-direction

D.R.Hamilton, A.Lemonick, F.M.Pipkin, Phys. Rev. 92, 1191(1953); 90, 370A(1953).

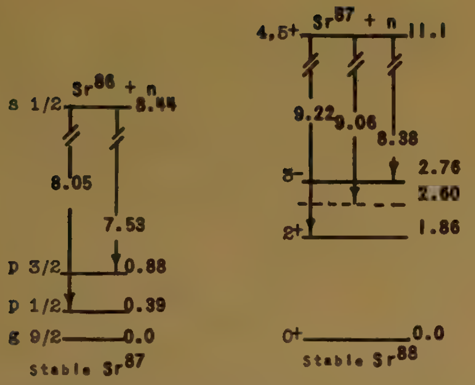
Sr

Capture γ's Sr(n,γ) s pr

2†	5.43	5 †	6.95
2†	5.82	5 †	7.53*
4†	6.10	1.1 †	8.05*
5†	6.27	1.3 †	8.38*
6†	6.67	0.1 †	9.06*
6†	6.87	0.06†	9.22*

Also graph $E_\gamma = 2.5$ to 9.5
$B_n(Sr^{86?}) = 8.5$; $B_n(Sr^{87?}) = 11.2$ from γ,n
*See decay scheme for probable assignments
†Photons per 100 n captures

Sr



B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051(1953).

Sr^{82}
38 44
26^d

τ 27^d Zr(190-Mev d) chem

Parent 1.25^mRb; not p 6.3^hRb (<0.1%)

L.M.Litz, S.A.Ring, W.R.Balkwell, Phys. Rev. 92, 288 (1953).

Zr

Capture γ's Zr(n,γ) s pr

16†	6.30
0.5†	7.38
1†	7.71
1†	8.66

Also graph E_γ = 3 to 9

$B_n(Zr^{90?})$ = 7.2; $B_n(Zr^{91?})$ = 8.7;

$B_n(Zr^{92?})$ = 6.6; from Zr(d,p)

†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051(1953).

Zr^{88}
40 48
85^d

τ 85^d Nb(100-Mev p) chem

Counted growth and decay of 105^d Y^{88} 1.85γ
0.26 to 2.9 years after bombardment

E.K.Hyde, Phys. Rev. 92, 927 (1953).

Zr^{91}
40 51
stable

μ -1.3 S

S.Suwa, J. Phys. Soc. Japan 8, 734(1953).

Nb^{94}
41 53
$2x10^{4y}$

Capture γ's Nb^{93}(n,γ) s pr

0.8†	5.90
0.8†	6.85
0.4†	7.19

Also graph E_γ = 2.5 to 7.7

$B_n(Nb^{93})$ = 7.3 from Nb^{93}(d,p)

†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025(1953).

Mo

Capture γ's Mo(n,γ) s pr

0.7†	6.39	0.2†	7.66
1.1†	6.66	0.1†	7.79
3.1†	6.92	0.5†	8.39*
0.3†	7.40	0.03†	9.15
0.7†	7.54*		

Also graph E_γ = 2.7 to 9.2

*Fit with known Mo^{96} levels if 9.15 γ is Mo^{96} g.s. transition

†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051(1953).

Mo^{93}
42 51
6.9^h

(0.26γ)(0.69γ)(θ) (0.26γ)(1.48γ)(θ)
(0.69γ)(1.48γ)(θ)
I = 23/2, 15/2, 11/2, 7/2

J.J.Kraushaar, Phys. Rev. 92, 318 (1953).

Tc^{98}
43 55
?

~42^m activity not assignable to Tc^{98}
Mo^{98}(7.4-Mev p) Mo^{95}(20-Mev α)

J.K.Lerohl, M.L.Pool, D.N.Kundu, R.A.House, Phys. Rev. 92, 934(1953).

Tc^{99}
43 56
$2.2x10^{5y}$

I 9/2 S
μ 5.5
Q +0.3

K.G.Kessler, R.E.Trees, Phys. Rev. 92,303, (1953).

Ru

Relative abundances $C_{10}H_{10}Ru$ ms

A	%	A	%
96	5.50	101	17.01
98	1.91	102	31.52
99	12.70	104	18.67
100	12.69		

L.Friedman, A.P.Irsa, J. Am. Chem. Soc. 75, 5741 (1953).

Neutron resonances (ev) E_n = 1 to 1000ev time of flight

	$\sigma_0\Gamma^2$
9.8	15
15.2	14
24.1	18.0
40.9	32.0

E.Melkonian, W.W.Havens, Jr., L.J.Rainwater, Phys. Rev. 92, 702 (1953).

$Rh^{98?}$
45 53
9^m

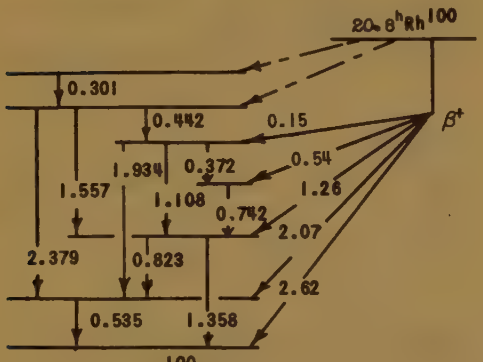
τ 9^m d 15^mPd chem
β^+ 4.0 a

A.H.W.Aten, Jr., T. de Vries-Hamerling, Physica 19, 1200 (1953).

Rh^{100} 45 55 20.8^{h}

τ		20.8^{h}	d 4.0^{d}Pd		
β^+	0.06†	0.15			sl
	3.6 †	0.54			
	13 †	1.26			
	39 †	2.07			
	45 †	2.62	F-K probably linear		
γ	5.3 *	0.301	1.5*	1.108	
	0.9 *	0.372	2.8*	1.358	
	21.3 *	0.442	1.1*	1.557	
	100.0 *	0.535	0.4*	1.934	
	0.6 *	0.742	1.0*	2.379	
	9.7 *	0.823	*Rel. intensity ce⁻		

$(ce^- \ 0.535\gamma)/\beta^+ = 0.062$ $\beta^+/\epsilon = 0.05$ (est.)



L.Marquez, Phys. Rev. 92,1511(1953).

Rh^{104} 45 59 4.3^{m} γ (0.051) $\alpha_K = 1.9$ scin

E.Germagnoli, A.Malvicini, L.Zappa, Nuovo Cim. 10, 1388 (1953).

Rh^{104} 45 59 44^{s} γ 0.552 scin

No other γ ($E_\gamma > 0.2$)

E.Germagnoli, A.Malvicini, L.Zappa, Nuovo Cim. 10, 1388 (1953).

Capture γ's $\mathrm{Rh}^{103}(n,\gamma)$ s pr

0.5†	5.55	0.7†	6.20
0.5†	5.91	0.2†	6.36
0.8†	6.06	0.2†	6.79

Also graph $E_\gamma = 3$ to 7.2

$B_n(\mathrm{Rh}^{103}) = 6.8$ from $\mathrm{Rh}^{103}(d,p)$

†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025(1953).

Rh^{106} 45 61 30^{s}

(0.624γ) (0.513γ) (θ) I = 0, 2, 0 scin

(1.045γ) (0.513γ) (θ) I = 2, 2, 0

γγ(θ) coefficients differ by 3% from theory

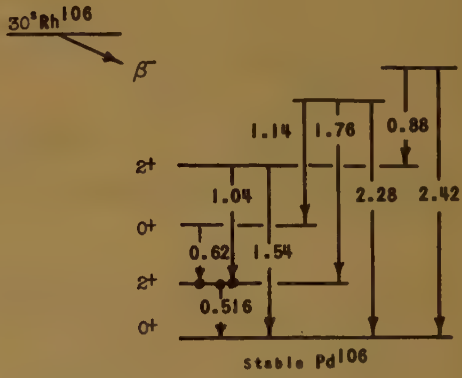
No (0.870γ) (1.045γ)

E.D.Klema, F.K.McGowan, Phys. Rev. 92,1469, (1953).

Rh^{106} 45 61 30^{s}

γ	20.5†	0.516		d 1.0^{y}Ru	scin
	10.4†	0.619	0.2†	1.54	
	0.3†	0.88	< 0.1†	1.76	
	1.7†	1.04	< 0.1†	2.28	
	0.4†	1.14	< 0.1†	2.42	

†Photons per 100 disintegrations



B.Kahn, W.S.Lyon, Phys. Rev. 92,902(1953).

$\mathrm{Pd}^{98?}$ 46 52 15^{m} τ 15^{m} Ru(52-Mev α) chem

p 9^{m}Rh chem

A.H.W.Aten, Jr., T. de Vries-Hamerling, Physica 19, 1200 (1953).

Pd^{100} 46 $54^{?}$ 4.0^{d} γ 0.0807 sl ce⁻

In 4^{d} activity with 21^{h}Rh from Ag(420-Mev p)

L.Marquez, Phys. Rev. 92, 1511 (1953).

Pd^{103} 46 57 17^{d} γ (0.040) K/LM = 0.16 pc

$\alpha_K = 70$

$E_{dis} = 0.076$ from $\epsilon_K/\epsilon_L = 1.3$

P. Avignon, J. phys. radium 14, 637 (1953).

Ag Capture γ's Ag(n,γ) s pr

1.1†	6.06	0.1†	6.95
0.4†	6.27	0.3†	7.06
0.4†	6.55	0.4†	7.27
0.2†	6.67		

Also graph $E_\gamma = 3$ to 7.4

$B_n(\mathrm{Ag}^{107?}) = 7.0$ from Ag(d,p)

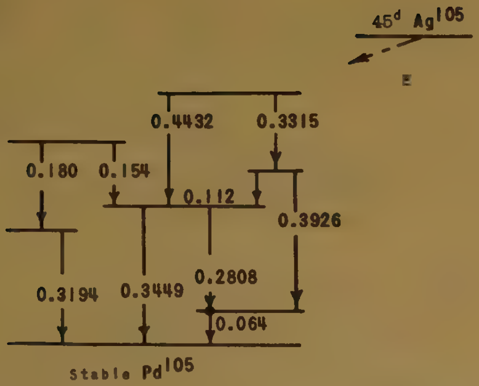
†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025(1953).

Ag^{105} 47 58 45^{d}

γ	0.0640		d 54.7^{m}Cd
	0.2808	$K/L_1 \geq 5$	sr ce⁻ ppl
	0.3194		
	0.3315		
	0.3449	$K/L_1 \geq 5$	
	0.3926		
	0.4432		

Ag^{105}
47 58
45^d



F.A.Johnson, Can. J. Phys. 31,1136(1953).

Ag^{107}
47 60
44^s

γ 0.0930 d 6.7^hCd sπ ce^-
$L_1 : L_2 : L_3 = 0.2 : 1 : 1$

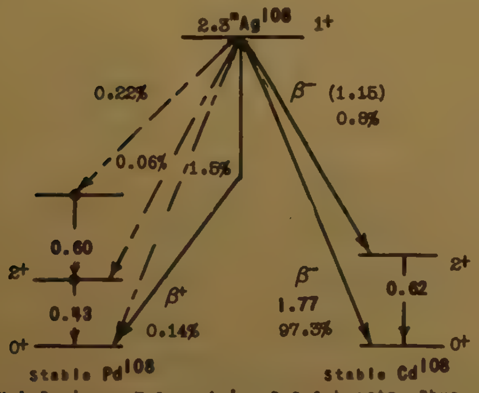
F.A.Johnson, Can. J. Phys. 31,1136(1953).

γ (0.094) $\alpha_K = 9.5$ E3 d 6.7^hCd
K/LM = 0.88 scin,sl ce^-

J.Brunner, O.Huber, R.Joly, D.Maeder, Helv. Phys. Acta 26, 588A(1953).

Ag^{108}
47 61
2.3^m

β^- (0.8%) (1.15) Ag(pile n) scin
97.3% 1.77
γ 100† 0.43 scin
79† 0.60
0.62
No 1.03γ No 0.19γ
(K x ray) (0.43γ, 0.60γ) (0.60γ) (0.43γ)
No $\beta^+ \gamma$
$\epsilon_K/\beta^- = 0.016$ pc
15% ϵ to excited levels xγ/x
$\beta^+/\beta^- = 0.0014$



M.L.Perlman, W.Bernstein, R.B.Schwartz, Phys. Rev. 92,1236(1953).

Ag^{109}
7 62
40^s

γ 0.0879 d 470^dCd sπ ce^-

F.A.Johnson, Can. J. Phys. 31,1136(1953).

Ag^{109}
47 62
40^s

γ 0.087 $\alpha_K \sim 8.6$ E3 d 13^hPd; pc

P. Avignon, J. phys. radium 14, 636 (1953).

γ (0.087) $\alpha_K = 12.4$ E3 d 470^dCd
K/LM = 0.85 scin,slce^-

J.Brunner, O.Huber, R.Joly, D.Maeder, Helv. Phys. Acta 26, 588A(1953).

Cd^{105}
48 57
54.7^m

τ 54.7^m Ag(20-Mev p) chem
β^+ 0.80 sl
1.691
γ 0.0255 $L_2L_3/MN = 4$ $L_2 << L_3$
0.0277 sπ ce^-
0.2630 0.3249 1.908
0.2925 0.3363 1.96
0.3080* 0.3407 2.00
0.3121 0.3470* 2.045
0.3171 0.4331* 2.277
0.3205* 0.6067 2.32
No $\beta^+\gamma$ for $E_\gamma > 0.5$
*Most intense lines

F.A.Johnson, Can. J. Phys. 31,1136(1953); Proc. Roy. Soc. Canada, 46,135A(1952).

Cd^{109}
48 61
470^d

$E_\epsilon = 0.07$ from $\epsilon_L/\epsilon_K = 0.28$ 3 4π scin
$E_{dis} = 0.07 + 0.087$ (E_γ)

E. der Mateosian, Phys. Rev. 92,938(1953); 87, 193A(1952).

Cd^{111}
48 63
48.7^m

γ (0.15) E3 > 99.7% $\gamma\gamma(\theta)$
(0.15γ) (0.25γ) (θ) I = 11/2, 5/2, 1/2
Molten Cd metal

J.J.Kraushaar, R.V.Pound, Phys. Rev. 92,523, (1953).

Cd^{114}
48 66
stable

Capture γ's Cd(n,γ) s pr

2.2 †	5.94	0.12†	7.84
0.36†	6.82	0.23†	8.483
0.21†	7.67	0.14†	9.046
0.16†	7.73		

Also graph $E_\gamma = 2.8$ to 9.5
$B_n(\mathrm{Cd}^{113}) \sim 9$ from mass measurements
†Photons per 100 n captures in Cd

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051(1953); Phys. Rev. 90, 355A(1953).

In^{114}
49 65
72^s

β^+ 0.004% ~1.2 a
γ (0.722) M1 96% E2 4% $\gamma\gamma(\theta)$
(0.72γ) (0.51γ) (θ) I = 2, 2, 0
No low energy β^- (<0.1%) $\alpha\beta\gamma$

M.W.Johns, C.C.McMullen, R.J.Donnelly, S.V. Nablo, Can. J. Phys. 32, 35 (1954).

In^{116}
49 67
13^s

τ_2 13^s Sn(14-Mev n)
β^- ~2.8 a

Z.Wilhelmi, R.Brunsz, C.Dabrowski, Bull. Acad Polon. Sci. 1, 105 (1953).

In^{116} $_{49}$ $_{67}$ 13^s

Capture γ's In(n,γ) s pr

1.1†	4.97	0.4†	5.55
1.0†	5.17	0.3†	5.73
0.8†	5.34	0.7†	5.86

Also graph $E_\gamma = 3$ to 8.2

$B_n(In^{115}) = 6.6$ from In(d,p)

†Photons per 100 n captures in In

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025(1953).

In^{118} $_{49}$ $_{69}$ 4.5^m

τ_1 4.5^m Sn(14-Mev n)

Z.Wilhelmi, R.Brunsz, C.Dabrowski, Bull. Acad Polon. Sci. 1, 105 (1953).

Sn

Capture γ's Sn(n,γ) s pr

0.4† 9.35

Also graph $E_\gamma = 3$ to 9.5

†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

Sb

Capture γ's Sb(n,γ) s pr

0.5†	5.43	1.1†	6.33
1†	5.61	1.6†	6.50
1†	5.89	0.7†	6.80
1†	6.11		

Also graph $E_\gamma = 3$ to 8

$B_n(Sb^{121?}) = 6.6$ from Sb(d,p)

†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025 (1953).

Sb^{121} $_{51}$ $_{70}$ stable

q -1.3 S

Based on $q(Sb^{123})/q(Sb^{121}) = 1.26$*

G.Sprague, D.H.Tomboulian, Phys. Rev. 92,105 (1953); 91,476A(1953); *H.G.Dehmelt, H.Kruger Z.Physik 130, 385 (1951).

Sb^{123} $_{51}$ $_{72}$ stable

q -1.7 S

G.Sprague, D.H.Tomboulian, Phys. Rev. 92,105 (1953); 91, 476A(1953).

Sb^{124} $_{51}$ $_{73}$ 60^d

γ (0.60) ▬

(2.27β)(0.60γ) polarization-direction

D.R.Hamilton, A.Lemonick, F.M.Pipkin, Phys. Rev. 92, 1191(1953); 90, 370A(1953).

I^{125} $_{53}$ $_{72}$ 60^d

$E_\epsilon = 0.11$ from $\epsilon_L/\epsilon_K = 0.23$ 3 4π scin

$E_{dis} = 0.11 + 0.035$ (E_γ)

E. der Mateosian, Phys. Rev. 92,938(1953); 87, 193A(1952).

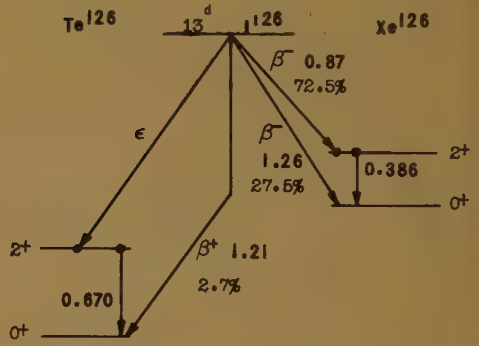
I^{126} $_{53}$ $_{73}$ 13^d

β^-	72.5†	0.87	I(28-Mev d) chem; sl
	27.5†	1.26	
β^+	2.7†	1.21	
γ			sl ce^- pe^- scin
		0.386	$\alpha_K = 0.017$ K/LM$\geq$8
		0.670	

No 0.54 β^+ (<1.3†)

(0.87β)(0.39γ) (K X ray)(0.67γ)

$\epsilon_K/(0.67\gamma) = 1.35$ $(0.67\gamma)/(0.39\gamma) = 1.0$



N.Marty, H.Langevin, P.Hubert, J.Phys.radium 14, 663 (1953); Compt. rend. 236,1153 (1953).

I^{128} $_{53}$ $_{75}$ 25.0^m

γ 0.436 scin

E.Germagnoli, A.Malvicini, L.Zappa, Nuovo Cim. 10, 1388 (1953).

Cs^{137} $_{55}$ $_{82}$ 33^y

β^- 0.518 $\Delta I = 2$ yes shape sl

γ 0.663 $\alpha_K = 0.096$

K : L : M = 4.6 : 1 : 0.07

T.Azuma, J. Phys. Soc., Japan 9, 1 (1954).

Ba

Capture γ's Ba(n,γ) s pr

5†	3.66	0.4†	6.44
13†	4.10	0.4†	6.68
3†	4.70	0.1†	7.18
1†	4.98	0.1†	7.79
3.7†	5.74	0.1†	9.23
1†	6.06		

Also graph $E_\gamma = 2.5$ to 9.5

Ba(γ,n) thresholds known at 6.8 and 8.6

†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051(1953).

La^{139} $_{57}$ $_{82}$ stable

q 0.9 S

K.Murakawa, T.Kamei, Phys. Rev. 92,325(1953).

Pr^{142} 59 83 19.2^h
Capture γ's $Pr^{141}(n,\gamma)$ s pr
3† 4.69 3† 5.67
2† 4.79 2† 5.83
3† 5.16
Also graph $E_\gamma = 2.5$ to 6.5
$B_n(Pr^{141}) = 5.65$ from $Pr^{141}(d,p)$*
†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025 (1953); *N.S.Wall, priv. comm.

Sm^{146} 62 84 5×10^{7y}
τ 5×10^{7y} Nd(40-Mev α) chem
α 2.55 ppl
τ from yield relative to $410^d Sm^{145}$, $47^h Sm^{153}$

D.C.Dunlavey, G.T.Seaborg, Phys. Rev. 92, 206 (1953).

Sm^{150} 62 88 stable
Capture γ's Sm(n,γ) s pr
0.07† 5.99 0.3† 7.24
0.06† 6.54 0.03† 7.89*
0.04† 6.79
Also graph $E_\gamma = 2.5$ to 8
*Probably not g.s. γ which would be M3 or E4
†Photons per 100 n captures in Sm

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

Gd
Capture γ's Gd(n,γ) s pr
0.3† 5.61 0.5† 6.73
0.2† 5.87 0.03† 7.36
0.2† 6.41 0.03† 7.78
Also graph $E_\gamma = 3$ to 8
†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

Gd^{159} 64 95 18.0^h
β^- ~0.9 Gd(pile n)
~1.1 $a\beta\gamma$
γ 0.0575 sπ ce^-
0.364
(~0.9β)(0.36γ) (~1.1β)(0.058γ)
No (K x ray)(0.36γ)

W.C.Jordan, J.M.Cork, S.B.Burson, Phys. Rev. 92, 315 (1953).

Gd^{161} 64 97 3.6^m
τ 3.73^m *10* Gd(pile n)
β^- ~1.6 a
γ 0.102 scin
0.165 ?
0.316
0.360
x K x ray (Tb) crit a
(0.102γ)(0.316γ) (0.36γ)(K x ray)
No (0.316γ)(0.36γ)
(β)(all γ's and K x ray)

W.C.Jordan, J.M.Cork, S.B.Burson, Phys. Rev. 92, 315 (1953).

Tb^{149} 65 84 4.1^h
$\alpha/\epsilon > 2 \times 10^{-3}$ Gd(75-Mev p) chem

M.A.Rollier, J.O.Rasmussen, Jr., Rend. acad. nazl. Lincei 14, 526 (1953); UCRL-2079.

Tb^{154} 65 89 17.2^h
τ 17.2^h Eu(38-Mev α) chem
β^+ 1.66 $s\pi\sqrt{2}$
2.75
ce^- 0.188
0.233
0.281
0.322
0.374
0.517
0.549

M.A.Rollier, J.O.Rasmussen, Jr., Rend. acad. nazl. Lincei 14, 526 (1953); UCRL-2079.

$Tb^?$ 65 $\sim17^h$
τ $\sim17^h$ Eu(38-Mev α) chem
β^- 2.34 $s\pi\sqrt{2}$

M.A.Rollier, J.O.Rasmussen, Jr., Rend. acad. nazl. Lincei 14, 526 (1953); UCRL-2079.

$Tb^?$ 65 $>17^h$
τ $>17^h$ Eu(38-Mev α) chem
β^+ 3.1 $s\pi\sqrt{2}$
ce^- 0.08 0.15
0.09 0.21
0.13

M.A.Rollier, J.O.Rasmussen, Jr., Rend. acad. nazl. Lincei 14, 526 (1953); UCRL-2079.

Dy^{161} 66 95 stable
I 7/2? S
$\mu(Dy^{161})/\mu(Dy^{163}) \sim 1$ S

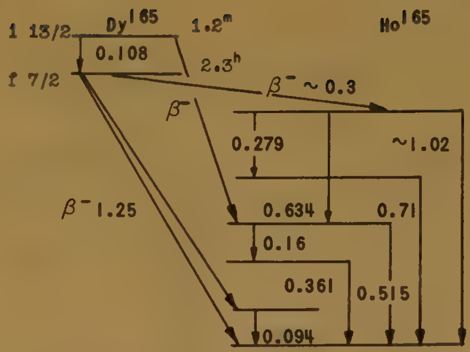
K.Murakawa, T.Kamei, Phys. Rev. 92, 325 (1953).

Dy^{163} 66 97 stable
I 7/2? S
K.Murakawa, T.Kamei, Phys. Rev. 92, 325 (1953).

Dy^{165} 66 99 1.2^m
β^- (0.84)(calc) Dy(pile n); sπ ppl
γ 0.108 $a_K \sim 4$ scin, sπ ce^- ppl
K : L_8 : L_8 : M : N
3 : 10 : 10 : 5 : 1.5
0.16
0.36
0.515
(0.16γ)(0.36γ)

Dy^{165} 66 99 2.32^h
γ 0.0944 scin, sπ ce^- ppl
K : L : M
60 : 7.8 : 1.5
0.279 K/L > 5
0.361 K/L > 5
0.634
0.71
~1.02
(~1.2β)(0.094γ) (~0.3β)(all other γ's)
(0.28γ)(0.71γ) (0.63γ)(0.36γ) No other $\gamma\gamma$

Dy^{165}
66 99
2.32^h



W.C.Jordan, J.M.Cork, S.B.Burson, Phys. Rev. 92, 1218 (1953).

Ho Neutron resonances (ev) $E_n = 0.1$ to 30 ev

3.96 $\sigma_0\Gamma^2 \sim 77$ cryst s
12.8 $\sigma_0\Gamma^2 \sim 300$
19
22
39

H.L.Foote, Jr., H.H.Landon, V.L.Sailor, Phys. Rev. 92, 656(1953); 90,362A(1953).

Ho^{163}
67 96

τ $<30^m$ or $>1^y$ d 75^mEr chem
No 5^d activity (<0.01% 4.6^hHo) Dy(24-Mev p)

T.H.Handley, E.L.Olson, Phys. Rev. 92,1260 (1953).

Er^{163}
68 95
75^m

τ 75^m Ho^{165}(19-Mev p) chem
γ 0.43 scin
1.10
No β^+ (<1%)
τ of daughter $<30^m$ or $>1^y$ chem
Mass assignment from 19-Mev threshold

T.H.Handley, E.L.Olson, Phys. Rev. 92,1260 (1953).

Tm Neutron resonances (ev) $E_n = 0.1$ to 30 ev

3.92 $\sigma_0\Gamma^2 \sim 380$ cryst s
14.8
17.6

H.L.Foote, Jr., H.H.Landon, V.L.Sailor, Phys. Rev. 92, 656(1953); 90,362A(1953).

Tm^{165}
69 96
24.5^h

τ 24.5^h Er (>12-Mev p) chem
D 9.9^hEr chem
γ 0.205 scin
0.806
1.16
1.38
No β^+ (< 1%)

T.H.Handley, E.L.Olson, Phys. Rev. 92,1260 (1953).

Lu Neutron resonances (ev) $E_n = 0.03$ to 35ev cryst s

	$\sigma_0\Gamma^2$
0.142	1.4
1.57	0.9
2.62	6
4.80	21
5.30	45
11.4	58
14.4	(560)*
20.6	
24	
31	

*2 or more unresolved resonances

H.L.Foote, H.H.Landon, V.L.Sailor, Phys.Rev. 92, 656(1953); 90, 362A(1953).

Hf^{178}
72 106
stable

Resonances Hf^{177}(n,γ) chopper

E_0 (ev)	$\sigma_0\Gamma^2$	σ_0	Γ
1.02	110	~55.000	~0.045
2.34	280	>30,000	<0.10
5.7	52	>. 2,400	<0.15
6.5	80	>. 7,200	<0.11
8.8	55	>. 3,600	<0.12
13.6	28	>. 450	<0.25

Capture γ's per pile n capture = 4.1

L.M.Bollinger, S.P.Harris, C.T.Hibdon, C.O. Muehlhause, Phys. Rev. 92,1527(1953); 87,222A. (1952).

Hf^{179}
72 107
stable

Resonance Hf^{178}(n,γ) chopper
7.6 ev $\sigma_0\Gamma^2 \sim 1400$ $\Gamma < 0.26$
Capture γ's per pile n capture = 3.5

L.M.Bollinger, S.P.Harris, C.T.Hibdon, C.O. Muehlhause, Phys. Rev. 92,1527(1953); 87, 222A(1952).

Hf^{180}
72 118
stable

Resonance Hf^{179}(n,γ) chopper
5.6 ev $\sigma_0\Gamma^2 \sim 25$ $\Gamma < 0.1$

L.M.Bollinger, S.P.Harris, C.T.Hibdon, C.O. Muehlhause, Phys. Rev. 92,1527(1953); 87, 222A(1952).

Hf^{181}
72 109
46^d

τ 46^d 4
γ (0.133) $\tau = 18.6^{\mu s}$ 5 $\beta\gamma$

H.S.Murdoch, Proc. Phys. Soc. 66A, 944(1953).

Ta Neutron resonances (ev) $E_n = 5$ to 5000ev time of flight

	$\sigma_0\Gamma^2$
4.1	55.4
6.1?	
10.2	48
13.7	11
20.0	10.3
24.0	39
35.1	200
38.2	280

E.Melkonian, W.W.Havens, Jr., L.J.Rainwater, Phys. Rev. 92, 702(1953).

Ta^{181}
73 108
stable

γ's $Ta^{181}(p,p'\gamma)$ $E_p = 2.0$ s ce$^-$

0.137 *1*
0.166 *1*

T.Huus, J.H.Bjerregaard, Phys. Rev. 92,1579, (1953).

Ta^{182}
73 109
111^d

Resonances $Ta^{181}(n,\gamma)$ $E_n = 0.3$ to 50ev
crystal s

E_o (ev)	$\sigma_o\Gamma^2$
4.29	59
10.36	32
13.9	12
20.7	7
24.2	27
36.7	~250
39.4	~180

R.L.Christensen, Phys. Rev. 92,1509(1953).

Capture γ's $Ta^{181}(n,\gamma))$ s pr

1 †	4.84	0.3†	5.57
0.5†	5.05	0.3†	5,78
0.5†	5.21	0.7†	6.07
0.3†	5.38		

Also graph $E_\gamma = 2.5$ to 8.0
$B_n(Ta^{181}) = 6.0$ from $Ta^{181}(d,p)$
†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025 (1953).

Ta^{183}
73 110
5^d

τ 5.2^d $Ta^{181}(n,\gamma)(n,\gamma)$
β^- 0.56 s
γ 0.046481 *5* cryst

	0.046481	*5*			
	0.052593	*5*	18†	0.16234	*3*
w	0.083	*1*	6	0.19269	*7*
14†	0.09907	*1*	18†	0.20506	*5*
24†	0.10793	*1*	19†	0.20982	*4*
4†	0.10973	*1*	w	0.236	*1*
1†	0.1104	*2*	30†	0.24426	*4*
4†	0.14377	*5*	100†	0.24605	*3*
27†	0.14415	*5*	25†	0.29171	*6*
11†	0.16053	*3*	26†	0.31308	*7*
33†	0.16146	*3*	39†	0.35404	*9*

J.W.M.DuMond, H.C.Hoyt, P.E.Marmier, J.J. Murray, Phys. Rev. 92, 202 (1953).

W

Capture γ's W(n,γ) s pr

2.4†	4.67	0.3†	6.02?
0.6†	4.94	3.8†	6.182*
2.3†	5.14	0.3†	6.40
3.4†	5.245	0.1†	6.73
2.4†	5.304	0.3†	7.42**
0.3†	5.77		

Also graph $E_\gamma = 3$ to 7.5
$*W^{183}$? $**W^{184}$?
W(γ,n) thresholds known at 6.3 and 7.2
†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

W^{181}
74 107
140^d

γ 0.1365 K/L ~8 W^{180}(pile n)
0.1525 K/L ~8 s/m ce$^-$
$\gamma\gamma$?
No other γ ($< 10^{-6}$ of K x rays) scin

J.M.Cork, W.H.Nester, J.M.LeBlanc, M.K.Brice, Phys. Rev. 92, 119 (1953).

W^{182}
74 108
stable

γ $W^{182}(p,p'\gamma)$ $E_p = 2.5$
0.101 scin

C.L.McClelland, H. Mark, C.Goodman, Phys. Rev. 93, 904 (1954).

γ W$(p,p'\gamma)$ $E_p = 1.75$
0.102 s ce$^-$

T.Huus, J.H.Bjerregaard, Phys. Rev. 92,1579, (1953).

W^{183}
74 109
stable

γ $W^{183}(p,p'\gamma)$ $E_p = 2.5$
0.103 scin

C.L.McClelland, H.Mark, C.Goodman, Phys. Rev. 93, 904 (1954).

W^{184}
74 110
stable

γ $W^{184}(p,p'\gamma)$ $E_p = 2.5$
0.112 scin

C.L.McClelland, H.Mark, C.Goodman, Phys. Rev. 93, 904 (1954).

γ W$(p,p'\gamma)$ $E_p = 1.75$
0.113 s ce$^-$

T.Huus, J.H.Bjerregaard, Phys. Rev. 92,1579, (1953).

W^{186}
74 112
stable

γ $W^{186}(p,p'\gamma)$ $E_p = 2.5$
0.124 scin

C.L.McClelland, H.Mark, C.Goodman, Phys. Rev. 93, 904 (1954).

γ W$(p,p'\gamma)$ $E_p = 1.75$
0.124 s ce$^-$

T.Huus, J.H.Bjerregaard, Phys. Rev. 92,1579, (1953).

W^{187}
74 113
23.9^h

$(0.480\gamma)(0.072\gamma, 0.134\gamma, 0.206\gamma)$ scin
$(0.134\gamma)(0.072\gamma, 0.480\gamma)$

E.Germagnoli, A.Malvicini, L.Zappa, Nuovo Cim. 10, 1388 (1953).

Re Neutron resonances (ev) $E_n = 0.003$ to 10^4 ev
time of flight

2.18*	$\sigma_o = 5700$	$\Gamma = 0.09$
4.40**	$\sigma_o = 2000$	$\Gamma = 0.05$
	$\sigma_o\Gamma^2$	
5.92	2.88	
7.18	15.0	
11.3**	29.6	
13.1	19.0	
17.7	44.7	
21.1	19.4	

*Re^{185} **Re^{187}

E.Melkonian, W.W.Havens, Jr., L.J.Rainwater, Phys. Rev. 92, 702 (1953).

$Re^{189?}$
75 114
9.8^m

τ 9.8^m Os(26-Mev n) chem
β^- 1.8 a

A.H.W.Aten, Jr., G.D.de Feyfer, Physica 19, 1143 (1953).

Ir^{191}
77 114
stable

I 3/2 S
μ +0.2
Q +1.5

W. von Siemens, Ann. Physik 13,136(1953).

Ir^{192}
77 115
1.4^m

β^- ~0.1% Ir(slow n); a
γ IT 99.9% 0.056 $\alpha \geq 1000$ s ce^-
No continuous ce^- (< 3%) a
No continuous γ (< 0.1%) a

G.Weber, A.Flammersfeld, Z. Naturf. 8a, 580, (1953).

Ir^{193}
77 116
stable

I 3/2 S
μ +0.2
Q +1.5

W. von Siemens, Ann. Physik 13,136(1953).

Pt Capture γ's Pt(n,γ) s pr

1.8†	5.24
1.1†	6.07
0.2†	7.26
0.3†	7.92

Also graph $E_\gamma = 3$ to 8
$B_n(Pt^{194?}) = 6.1$; $B_n(Pt^{195?}) = 8.1$
Both values from Pt(γ,n) and Pt(d,p)
†Photons per 100 n captures

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

Au^{195}
79 116
30^s

γ 0.0569 $\alpha \sim \infty$ E3
$L_2/L_3 = 1.05$
0.2615 $\alpha_K = 0.25$ M1 + E2
K : L : M = 100 : 18 : 5.3
0.318
d 40^hHg, not d 9.5^hHg

O.Huber, J.Halter, R.Joly, D.Maeder, J. Brunner, Helv. Phys. Acta 26, 591A (1953).

Au^{197}
79 118
7.4^s

γ 0.130 d 23^hHg Au(n,n'), scin
0.277 K: L: M = 100: 19: 4.7
$\alpha_K = 0.29$ M1 + E2
0.407 K/LM = 2.3
$\alpha \sim \infty$ M4 crossover

O.Huber, J.Halter, R.Joly, D.Maeder, J. Brunner, Helv. phys. Acta 26, 591A (1953).

Au^{197}
79 118
stable

μ 0.14 8
Q +0.56

W. v. Siemens, Ann. Physik 13, 158 (1953).

Au^{198}
79 119
2.69^d

γ (0.69) E2 60% M1 40% $\gamma\gamma(\theta)$
(0.69γ) (0.41γ) (θ) I = 2, 2, 0

C.D.Schrader, Phys. Rev. 92,928 (1953).

Capture γ's $Au^{197}(n,\gamma)$ s pr

3 †	4.59	1.8†	6.15
1.7†	5.20	6 †	6.249
1.3†	5.52	2.8†	6.310
1.6†	5.70	2.1†	6.45
1.8†	5.97	1.5†	6.495*

Also graph $E_\gamma = 3.5$ to 7.8
$B_n?(Au^{197}) = 6.4$ from Au^{197}(d,p)
*Probably not Au^{198} g.s. γ which would be M2
†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025 (1953).

Hg^{195}
80 115
40^h

τ_1 40^h
γ 0.0371 $\alpha \sim \infty$ $L_1/L_3 = \sim 10$
L : M : N = 100 : 33 : 18
0.1227 $\alpha \sim 200$ $L_2/L_3 = \sim 0.3$
K : L : M = 100 : 442 : 20
0.559 $\alpha_K = 0.028$
K : L : M = 100 : 19 : 4.6
p 9.5^hHg 50% p 30^sAu 50%

O.Huber, J.Halter, R.Joly, D.Maeder, J.Brunner Helv. phys. Acta 26, 591A(1953).

Hg^{195}
80 115
9.5^h

τ_2 9.5^h not p 30^sAu
γ 0.0614 $L_1L_2/L_3 = 1.8$
0.179
0.600
100† 0.779 $\alpha_K = 0.016$ K/LM = 4.3
40† 1.15

O.Huber, J.Halter, R.Joly, D.Maeder, J. Brunner, Helv. Phys. Acta 26, 591A (1953).

Hg^{197}
80 117
65^h

γ 0.0776 $\alpha = 2.5$ d 23^hHg
$L_1L_2/L_3 = 5$
0.192 $\alpha_K = 0.9$ M1
K : L : M = 100 : 16 : 4.8

O.Huber, J.Halter, R.Joly, D.Maeder, J.Brunner, Helv.Phys. Acta 26, 591A (1953).

Hg^{198} 80 118 stable

Level $Hg(\gamma,\gamma')$ $E_\gamma = 0.411$

(0.411) $\tau = 2.2 \times 10^{-11}s^*$

Source rotated to compensate for recoil

*With statistical weight factor of 5

W.G.Davey, P.B.Moon, Proc. Phys. Soc. 66A, 956 (1953).

Hg^{200} 80 120 stable

Capture γ's $Hg(n,\gamma)$ s pr

2†	4.66	3†	5.39
4†	4.73	5†	5.65
3†	4.83	12†	5.959
1†	4.95	5†	6.446
3†	5.07	0.3†	6.6 ?
		0.3†	7.1 ?

Also graph $E_\gamma = 2.5$ to 7.5

†Photons per 100 captures in Hg

B.B.Kinsey, G.A.Bartholomew, Can. J. Phys. 31, 1051 (1953).

Hg^{201} 80 121 ?

τ_1 $< 1^m$ or $> 10^m$ Hg^{204} ($\leq$ 20-Mev γ)

No γ activity ($< 1\%$ of expected M4 IT)

I.Bergstrom, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918 (1953).

Hg^{203} 80 123 ?

τ_1 $< 1^m$ or $> 10^m$ Hg^{204} ($\leq$ 20-Mev γ)

No γ activity ($< 1\%$ of expected M4 IT)

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918 (1953).

Tl

Capture γ's $Tl(n,\gamma)$ s pr

7†	4.72	4†	5.90
4†	4.91	8†	6.20
7†	5.25	4†	6.54
17†	5.63		

Also graph $E_\gamma = 2.5$ to 8

$B_n(Tl^{203?}) = 6.5$; $B_n(Tl^{205?}) = 6.2$ from Tl(d,p)

†Photons per 100 n captures

G.A.Bartholomew, B.B.Kinsey, Can. J. Phys. 31, 1025 (1953).

Tl^{198} 81 117 1.9^h

τ_1 1.9^h Hg(11-Mev d) chem

γ 0.0487 $s\pi$ ce$^-$

0.2607 K/L = 0.6 $L_1/L_3 = 1.33$ M4

0.2824 M1 + E2

$(ce^-_K\ 0.261\gamma)/(ce^-_K\ 0.282\gamma) = 1.45$

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918, 849A (1953).

Tl^{198} 81 117 5^h

τ_2 5^h Hg(11-Mev d) chem

γ 0.195

0.284

0.402

0.411

0.675

$(0.411\gamma)/(0.675\gamma) \sim 10$

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918, 849A (1953).

Tl^{199} 81 118 7^h

γ 0.0500 Hg(11-Mev d) chem

0.1584 $s\pi$ ce$^-$

0.2081

0.2472 $L_1/L_3 \sim 10$ M1

0.3336

0.4546 No L_3 ce$^-$ M1

0.4913 No L_3 ce$^-$ M1

Not p 44^m Hg(0.367γ not observed)

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918 (1953).

Tl^{200} 81 119 27^h

γ 0.116^* Hg(11-Mev d) chem

0.252 $s\pi$ ce$^-$

0.289

0.3678 K/L = 2.0 $L_1L_2/L_3 = 3.0$

0.579

0.629

0.660*

0.786*

0.829

*Assignment doubtful

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918 (1953).

Tl^{201} 81 120 3^d

γ 0.0305* M1 ? $s\pi$ ce$^-$

0.0321* M1 ?

0.1353 $L_1/L_3 \sim 10$ M1

0.1676 $L_1/L_3 \sim 10$ M1

No 0.21γ No 0.55γ

*Only L_1 ce$^-$ observed Hg(11-Mev d) chem

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918 (1953).

Tl^{202} 81 121 12^d

γ 0.4391 K/L = 2.8 $s\pi$ ce$^-$

$L_1L_2/L_3 = 3.5$ E2

No other γ Hg(11-Mev d) chem

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918 (1953).

Tl^{208} 81 127 3.1^m

$\Gamma(e^-_K\ 0.277\gamma) \sim 80$ ev $s\pi$

This is expected width of K electron level

H.Slätis, Arkiv Fysik 6, 415 (1953).

$Tl^?$

Unassigned ce$^-$ Hg(11-Mev d) chem

$\tau = 5^h$ to 27^h	0.0369	0.0376	0.1326	$s\pi$ ce$^-$
$\tau = 6^{h?}$	0.458 0.465	0.473 0.480	0.503 0.508	0.513
$\tau = 27^{h?}$	0.0814 0.0829 0.0838	0.0997 0.1371 0.2260	0.2717 0.2935 0.2996	0.3038
$\tau = ?$	0.1651 0.1887 0.1959 0.2015	0.3326 0.3336 0.3924 0.414	0.582 0.604 0.618 0.640	0.667 0.687

I.Bergström, R.D.Hill, G. de Pasquali, Phys. Rev. 92, 918 (1953).

Pb^{204} 82 122 68^{m}

γ (0.905) E4 90% M5 10% $\gamma\gamma(\theta)$

(0.905γ) (0.374γ) (θ) I = 6+, 2+, 0+

E4,M5 assignment based on α_K = 0.06

H.Frauenfelder, J.S.Lawson, Jr., W.Jentschke, G. DePasquali, Phys. Rev. 92, 1241 (1953).

Pb^{207} 82 125 0.82^{s}

(ce_K^- 1.06γ) (0.56γ) (θ) d~50^{y}Bi

I = 13/2, 5/2, 1/2 scin

F.K.McGowan, Phys. Rev. 92, 524 (1953).

Pb^{210} 82 128 22^{y}

β^- 0.023 3 pc

F-K plot linear to ~5 kev

E.Huster, Z. Physik 136, 303 (1953); Naturwiss. 40, 197 (1953); Phys. Rev. 92, 1076 (1953).

Pb^{212} 82 130 10.6^{h}

$\Gamma(e_K^-$ 0.238$\gamma)$, $\Gamma(e_K^-$ 0.300$\gamma)$ ~ 80 ev sπ

This is expected width of K electron level

H.Slätis, Arkiv Fysik 6, 415 (1953).

Pb^{214} 82 132 26.8^{m}

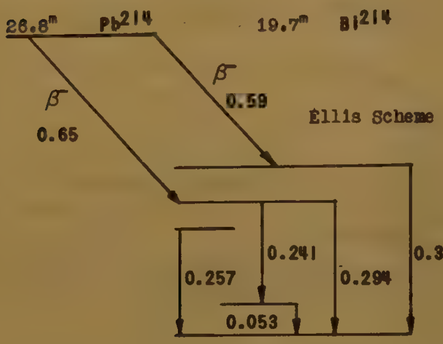
β^- 56% 0.59 Rn^{222} sπ

44% 0.65

(0.59β) (ce^-0.35γ) (0.65β) (ce^-0.29γ)

No (ce^-0.35γ) (ce^-0.29γ, ce^-0.24γ)

Supports decay scheme of Ellis



S.Kageyama, J. Phys. Soc. Japan 8, 689 (1953).

Bi^{206} 83 123 6.4^{d}

K : L_1L_2 : L_3 : M

γ 0.2025 0.084 : 0.57 : 0.25 : 0.2

0.516 18 : 10 : 2 : 3

τ = 150$^{\mu s}$

Both γ's interpreted as E3 from 7- fifth excited state at 2.200 in Pb^{206}

D.E.Alburger, M.H.L.Pryce, Phys. Rev. 92, 514, (1953).

Bi^{207} 83 124 ~50^{y}

γ 100 % 0.555 α_K = 0.015 $\tau < 10^{-9s}$ E2

81.5% 1.055 α_K = 0.096 τ = 0.8^{s} M4

(1.06γ) (0.56γ) (θ) I = 13/2, 5/2, 1/2 scin

No other γ's

F.K.McGowan, E.C.Campbell, Phys. Rev. 92, 523, (1953)

Bi^{207} 83 124 ~50^{y}

γ 1.0639 3 sπ √2

K/L = 3.95

K/LM = 3.00

D.E.Alburger, Phys. Rev. 92, 1257 (1953).

Bi^{209} 83 126 stable?

Levels Bi^{209}(n,n') E_n = 2.4 scin

0.23†	g.s
0.06†	0.9
0.03†	1.3

† $d\sigma/d\omega$

M.J.Poole, Phil. Mag. 44, 1398 (1953).

Bi^{210} 83 127 5.00^{d}

I 0?

No hfs in λ 3067 indicating g_I small

M.Fred, F.S.Tomkins, R.F.Barnes, Phys. Rev. 92, 1324 (1953).

Bi^{210} 83 127 2.6 x 10^{6y}

$\tau_{1/2}$ 2.6 x 10^{6y} 8

From difference between σ_t and σ(5.0^{d}Bi)

D.J.Hughes, H.Palevsky, Phys. Rev. 92, 1206 (1953).

Bi^{214} 83 131 19.7^{m}

β^- 20% 1.00? Rn^{222} sπ

57% 1.65

23% 3.2

S.Kageyama, J. Phys. Soc. Japan 8, 689 (1953).

Po^{210} 84 126 138.4^{d}

τ 138.37^{d} 3

0.5 millicurie sample counted 328 days in low geometry α counter

M.L.Curtis, Phys. Rev. 92, 1489 (1953).

Ra^{224} 88 136 3.64^{d}

α 4.9% 5.445 s

(5.681)

F.Asaro, F.Stephens, Jr., I.Perlman, Phys. Rev. 92, 1495 (1953).

Ra^{228} 88 140 6.7^{y}

~4% L x ray crit a

No 0.03γ (< 1%) crit a

M.Riou, Ann. Phys. 8, 535 (1953).

Th^{228} 90 138 1.90^{y}

α	0.2%	5.173	28 % 5.388		s
	0.4%	5.208	71 % 5.421		
γ	16 †	0.089	α ~ 16	E2	scin
	2.6†	0.137	$\alpha \ll 1$	E1	
	0.9†	0.169	α ~ 1.2	E2	
	2.7†	0.212	$\alpha \ll 1$	E1	

†Photons per 10^{3} α's

F.Asaro, F.Stephens, Jr., I.Perlman, Phys. Rev. 92, 1495 (1953).

Th^{228}	α_2	15%	5.21	Dpl
90 138	α_1	27%	5.34	
1.90^y	α_o	58%	(5.42)	

α_1[ce$^-$(0.084γ)]
α_2[~0.03 ce$^-$]

C.J.D.Jarvis, Proc. Phys. Soc. 66A, 1074(1953)

Th^{230}	γ	(0.068)	$\tau < 10^{-8s}$	90%	Th^{230}
90 140	(α)(0.068γ)(θ)	I = 0, 2, 0			scin
8.0×10^{4y}					

G.M.Temmer, J.M.Wyckoff, Phys. Rev. 92, 913; 849A(1953).

0.0518 e$^-$ (previously unassigned) attributed
to L_3 e$^-$ of 0.0678 γ (E2)

M.Riou, Ann. Phys. 8, 535 (1953).

U^{233}	I	5/2	S
92 141	μ	positive	
1.62×10^{5y}	Q	large	

K.L.Vander Sluis, J.R.McNally, Jr., J. Opt. Soc. Amer. 44, 87 (1954).

U^{234}	α	~3%	4.593	enriched U^{234}
92 142		23%	4.707	αe^- ic
2.5×10^{5y}		74%	(4.763)	

G.Valladas, Compt. rend. 237,1673 (1953).

U^{235}	I	5/2	S
92 143	μ	-0.8	
7.1×10^{5y}	Q	~8	

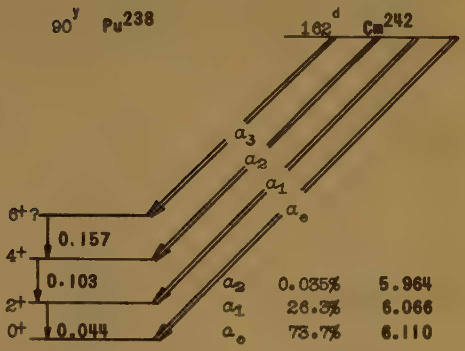
K.L.Vander Sluis, J.R.McNally, Jr., J. Opt. Soc. Amer., 44, 87 (1954).

Am^{242}	τ	16.01^h 2	Am^{241}(pile n)
95 147	Counted 10 samples each for 7 half lives		
16.0^h			

T.K.Keenan, R.A.Penneman, B.B.McInteer, J. Chem. Phys. 21, 1802 (1953); Phys. Rev. 87, 204A(1952).

Cm^{242}	α	0.035%	5.964		$Am^{241}(n,\gamma\beta)$	chem
96 146		26.3%	6.066			s
162^d		73.7%	6.110			
	γ	410†	0.044	α = 620		scin
		60†	0.100	α = 5		
		27†	0.157			

†Photons per 10^6 α's



F.Asaro, S.G.Thompson, I.Perlman, Phys. Rev. 92, 694 (1953).

Cm^{243}	α	13%	5.732	$Cm^{242}(n,\gamma)$	chem
96 147		81%	5.777		s
$\sim 100^y$		6%	5.985		
	γ		0.226		scin
			0.278		

(5.777α)(0.226γ,0.278γ)

F.Asaro, S.G.Thompson, I.Perlman, Phys. Rev. 92, 694 (1953).

Cm^{244}	α	5.755	$Pu^{242}(n,\gamma\beta)(n,\gamma\beta)$	chem
96 148		5.798		s
19^y				

F.Asaro, S.G.Thompson, I.Perlman, Phys. Rev. 92, 694 (1953).

2. NEUTRON CROSS SECTIONS

Absorption cross sections for neutron energies marked "th" (thermal) have been determined, from measurements in a thermal neutron flux, in terms of the cross section value of a "standard" for neutrons of velocity 2200 m/sec, or energy ~0.025 ev. The standard used is stated just after the reference and is generally one known to have a thermal absorption cross section with a 1/v energy dependence. If the nucleus whose cross section is being measured also has a cross section with 1/v dependence, the cross section found for it by comparison with the standard will, of course, be a cross section for 2200 m/sec. If not, and the dependence often is not known, the value found by the comparison is $\overline{\sigma v}$ /2200.

Target	Energy	σ	Value	Method	Ref.
H	19.93	t	0.50 *1*		53D28
	169	t	49 mb		53T20
H^2	169	t	23 mb		53T20
He	2.61-14.3	el(θ)	graphs	ic	53S69
	2.49	t	3.16		53C49
	2.99	t	2.79		53C49
	18.0	t	0.85		53D28
	19.0	t	0.82		53D28
	20.1	t	0.77		53D28
Li^6	1.5	n,t	0.32	ppl	54W6
	2.0	n.t	0.27	ppl	54W6
Li^7	~3	n,t	0.07	$12.4^y H^3$	54M14
B	0.001-0.036ev	t	graph	chopper	53C35
	0.0253 ev	a	749^* *4*		"
	*Value from 1/v line				
	<0.2% H_2O by weight in B_2O_3 sample				"
	0.0253 ev	a	755 *3*		53K54
C	2.20	el	1.65		53R25
	17.2	t	1.39		53D28
	19.0	t	1.45		53D28
	20.1	t	1.52		53D28
	169	t	0.323		53T20
O	169	t	0.430		53T20
	12-18	n,p	graph	$7.4^s N$	54M2
F	19.0	t	1.84		53D28
Al	2.5	el	1.0	scin	53P17
	2.5	n,1.6 n'	0.5	scin	53P17
	19.0	t	1.84		53D28
Si	19.0	t	1.94		53D28
P		s coh	3.7		53P21
	0.13-0.85	t	graph		53H35
S^{32}	pile	n,p	0.15	$14.3^d P$	53S66
A	0.45-1.10	t	graph		53G33

Target	Energy	σ	Value	Method	Ref.
Cr	$0.015-10^4$ ev	t	graphs		53M51
Fe	19.0	t	2.23		53D28
Fe^{54}	pile	n,p	11 mb	$320^d Mn$	53S66
Ni	2.8	el	0.9	scin	53P17
	2.8	n,1.4 n'	0.6	scin	53P17
Cu	19.0	t	2.56		53D28
Ga	$0.05-10^4$ ev	t	graphs		53M51
Br	17.2	t	3.12		53D28
	19.0	t	2.98		53D28
	20.1	t	2.96		53D28
Zr	19.0	t	3.60		53D28
Nb^{94}	pile	n,γ	~15	$35^d Nb$	53D18
Ru	$0.01-10^3$ ev	t	graphs		53M51
Sn^{116}	~14	n,p	0.9 mb	$13^s In$	53W48
Sn^{118}	~14	n,p	0.8 mb	$4.5^m In$	53W48
Nd	0.06-3	t	graph		5402
Sm	0.06-3	t	graph		5402
Ho^{165}	0.3-50 ev	t	graph		53F19
Er		s coh	7.8		53K53
	0.06-3	t	graph		5402
Tm^{169}	0.1-50 ev	t	graph		53F19
Yb	0.06-3	t	graph		5402
Lu	0.03-35 ev	t	graph		53F19
Hf	$1-10^3$ ev	t	graph		53B78
	0.06-3	t	graph		5402
Hf^{176}	0.8-16 ev	t	graph		53B78
Hf^{177}	th	a	~350	osc	"
	0.8-16 ev	t	graph		"
Hf^{178}	th	a	~90	osc	"
	0.8-16 ev	t	graph		"

Neutron Cross Sections - continued

Target	Energy	σ	Value	Method	Ref.
Hf^{179}	th	a	~75	osc	53B78
	0.8-16 ev	t	graph		"
Hf^{180}	0.8-16 ev	t	graph		"
Ta^{181}	0.3-50 ev	t	graph		53C45
	5-5000 ev	t	graph		53M51
Ta^{182}	th	n,γ	$\gtrsim 10^{4}$	5.2^{d}Ta	53D20
W	2.5	n,~1.5 n'	1.3	scin	53P17
	2.5	n,>2 n'	1.6	scin	53P17
Re	$0.003-10^{4}$ ev	t	graph		53M51
Au^{197}	0.0013-0.036ev	t	graph		53C35
	0.0253 ev	a	98.7^{*} 6		53C35
	*Value from 1/v line plus 1% for 4.9 ev res				
	2.5	n,~1.5 n'	0.9	scin	53P17
	2.5	n,>2 n'	2.5	scin	53P17
Pb	19.0	t	5.96		53D28
Bi^{209}	2.4	el	2.9	scin	53P17
	2.4	n, 1.5 n'	0.8	scin	53P17
	2.4	n, 1.1 n'	0.3	scin	53P17
	19.0	t	5.69		53D28
	45-131	t	table		54L4
U	18.0	t	6.14		53D28
	19.0	t	5.94		53D28
	20.1	t	6.29		53D28
	45-131	t	table		54L4

Neutron Cross Sections - continued

53B78 L.M.Bollinger, S.P.Harris, C.T.Hibdon, C.O. Muehlhause, Phys. Rev. 92,1527(1953); 87,222A (1952); Based on σ_a(B) = 755

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53G33 J.B.Guernsey, C.Goodman, Phys. Rev. 92,323(1953); 91, 404A(1953).

53H35 K.F.Hansen, R.M.Kiehn, C.Goodman, Phys. Rev. 92, 652(1953).

53K53 W.C.Koehler, E.O.Wollan, Phys. Rev. 92,1380 (1953).

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53P17 M.J.Poole, Phil. Mag. 44, 1398(1953); isotropy assumed.

53P21 S.W.Peterson, H.A.Levy, S.H.Simonsen, J. Chem. Phys. 21, 2084 (1953).

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53S66 G.H.Stafford, L.H.Stein, Nature 172,1103(1953).

53S69 J.D.Seagrave, Phys. Rev. 92,1222(1953).

53T20 A.E.Taylor, Phys. Rev. 92, 1071(1953).

53W48 Z.Wilhelmi, R.Brunsz, C.Dabrowski, Bull. Acad. Polon, Sci. 1, 105 (1953).

54L4 W.I.Linlor, B.Ragent, Phys. Rev. 92,835(1953); 93, 951A (1954).

54M2 H.C.Martin, Phys. Rev. 93, 498 (1954).

54M14 R.L.Macklin, H.E.Banta, Science 119, 350(1954).

54O2 A.Okazaki, S.E.Darden, R.B.Walton, Phys. Rev. 93, 461 (1954).

54W6 J.B.Weddell, J.H.Roberts, Phys. Rev. 93,924A (1954).

3. GROUND STATE Q'S

For these data it seemed impractical to follow the policy adhered to in the main list of giving the A value of a target nucleus only when enriched material was used or when the target element is known to be monoisotopic. In the following reactions, the A values assigned by the experimenters to target and product nuclei are given as superscripts. In cases where enriched material was used, the superscript is underlined.

The standard given is that used for the measurement of the energy of either the incident or the emitted light particle whichever presented the greatest difficulty. In cases where the same standard was used for both measurements, special mention of this fact is made in the footnote giving the value assigned to the standard.

Reaction	Value		Source	Detector	Standard	Ref.
$H^{3}(He^{3},p)He^{5}$	+11.08		CcW	scin	range energy^{a}	53M61
$He^{5} \longrightarrow He^{4}+n$	+1.00	8	From $H^{3}(He^{3},p)He^{5}$ Q			53M61
$Be^{8} \longrightarrow 2He^{4}$	+0.0775		value retracted			53A34
$B^{10}(\alpha,d)C^{12}$	+1.39	1		s		53S64
$B^{10}(\alpha,p)C^{13}$	+4.13	2		s		53S64
$B^{11}(d,p)B^{12}$	+1.140	8	VdG	s	Po α^{b}	53E12
$B^{11}(\alpha,p)C^{14}$	+0.85	2		s		53S64

Reaction	Value		Source	Detector	Standard	Ref.
$N^{14}(p,n)O^{14}$	-6.0	2	Cyc	ppl		54A4
$N^{14}(\alpha,p)O^{17}$	-1.16		Po α	ppl		53H33
$Cl^{35}(\alpha,p)A^{38}$	+0.81	8	Cyc	a		53K31
$V^{51}(d,p)V^{52}$	+5.072	8	VdG	s	Po α^{b}	53S56
$Zn^{\underline{68}}(d,p)Zn^{69}$	+4.16	15		scin		54E2
$As^{75}(n,\gamma)As^{76}$	+7.30	4	Pile	s pr	P res	53B76
$Se^{76}(n,\gamma)Se^{77*}$	+7.416	9	Pile	s pr	P res	53K45

Ground State Q's - continued

Reaction	Value		Source	Detector	Standard	Ref.
$Se^{77}(n,\gamma)Se^{78*}$	+10.483	*14*	Pile	s pr	P res	53K45
$Kr^{\underline{84}}(d,p)Kr^{85}$	+3.72	*5*	Cyc	a		53W34
$Kr^{\underline{86}}(d,p)Kr^{87}$	+3.30	*5*	Cyc	a		53W34
$Sr^{86}(n,\gamma)Sr^{87*}$	+8.433	*14*	Pile	s pr	P res	53K45
$Sr^{87}(n,\gamma)Sr^{88*}$	+11.07	*6*	"		"	53K45
$Zr^{91}(n,\gamma)Zr^{92*}$	+8.66	*4*	"		"	53K45
$Nb^{\underline{93}}(n,\gamma)Nb^{94}$	+7.19	*3*	"		"	53B76
$Mo^{95}(n,\gamma)Mo^{96*}$	+9.15	*5*	"		"	53K45
$Rh^{\underline{103}}(n,\gamma)Rh^{104}$	+6.792	*14*	"		"	53B76
$Ag^{107}(n,\gamma)Ag^{108*}$	+7.27	*2*	"		"	53B76
$Cd^{113}(n,\gamma)Cd^{114}$	+9.046	*8*	"		"	53K45

Mass assignment because of large σ_a (Cd^{113})

Reaction	Value		Source	Detector	Standard	Ref.
$Sb^{121}(n,\gamma)Sb^{122*}$	+6.80	*4*	Pile	s pr	P res	53B76
$Pr^{\underline{141}}(n,\gamma)Pr^{142}$	+5.83	*3*	"		"	"
$Sm^{149}(n,\gamma)Sm^{150}$	≥7.89	*6*	"		"	53K45

Mass assignment because of large σ_a (Sm^{149}). See Sm^{150}.

Reaction	Value		Source	Detector	Standard	Ref.
$Ta^{\underline{181}}(n,\gamma)Ta^{182}$	+6.06	*7*	Pile	s pr	P res	53B76
$W^{182}(n,\gamma)W^{183*}$	+6.182	*8*	"		"	53K45
$W^{183}(n,\gamma)W^{184*}$	+7.42	*2*	"		"	"
$Pt^{194}(n,\gamma)Pt^{195*}$	+6.07	*4*	"		"	"

Ground State Q's - continued

Reaction	Value		Source	Detector	Standard	Ref.
$Pt^{195}(n,\gamma)Pt^{196*}$	+7.920	*12*	Pile		P res	53K45
$Au^{\underline{197}}(n,\gamma)Au^{198}$	≥6.494	*8*	"		"	53B76
See Au^{198} in main list.						
$Tl^{203}(n,\gamma)Tl^{204*}$	+6.54	*3*	"		"	"
$Tl^{205}(n,\gamma)Tl^{206*}$	+6.20	*3*	"		"	"

a Range energy data of Smith, Phys. Rev. 71, 32(1947)

b H_p (Po α) = 331,590. This standard was used for both incident and emitted particles.

* For evidence for mass assignment see item(by same authors) in main list under this nucleus or appropriate element.

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53M61 C.D.Moak, Phys. Rev. 92,383; 91,462A(1953).
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53W34 G.W.Wheeler, R.B.Schwartz, W.W.Watson, Phys. Rev. 92, 121 (1953).
54A4 F.Ajzenberg, W.Franzen, J.G.Likely, Phys. Rev. 93, 925A (1954).
54E2 F.S.Eby, R.D.Hill, W.K.Jentschke, Phys. Rev. 93, 925A (1954).

4. MASS DIFFERENCES AND RATIOS

Where no superscript have been used with H, C, and O, the weights of the most abundant isotopes, namely 1, 12, and 16 respectively, are to be understood.

Differences are given in millimass units

	Value		Ref.
$N^{14} - CH_2$	+12.591	*13*	53E15
$N_2^{14} - C_2H_4$	+25.177	*21*	"
$O^{16} - CH_4$	+36.399	*28*	"
$(Si^{30} - Si^{29})/(Si^{30} - Si^{28})$	0.49934	*3*	53W39
Cl^{35}/Cl^{37}	0.945978	*3*	53H51
$A^{40} - C_3H_4$	+69.052	*44*	53E15
$3Ti^{47} - Pr^{141}$	-50.9	*3*	53H58
$3Ti^{48} - Nd^{144}$	-66.7	*3*	"
$3Ti^{50} - Nd^{150}$	-85.2	*5*	"
$3Cr^{52} - Gd^{156}$	-100.4	*4*	"
$3Mn^{55} - Ho^{165}$	-84.8	*8*	54H4
$3Fe^{56} - Er^{168}$	-126.0	*3*	"
$3Ga^{69} - Pb^{207}$	-196.6	*6*	53H58

MASS DIFFERENCES AND RATIOS continued

	Value		Ref.
2Ge^{70} - Ce^{140}	-56.8	*6*	53H58
2Ge^{72} - Nd^{144}	-66.3	*2*	"
2Ge^{72} - Sm^{144}	-66.9	*8*	54H4
2Ge^{73} - Nd^{146}	-65.8	*4*	"
2Ge^{74} - Nd^{148}	-74.8	*2*	"
2Ge^{74} - Sm^{148}	-71.9	*4*	"
2Ge^{76} - Sm^{152}	-76.2	*2*	53H58
2As^{75} - Nd^{150}	-77.4	*4*	54H4
2As^{75} - Sm^{150}	-72.5	*8*	"
2Se^{74} - Nd^{148}	-72.3	*4*	"
2Se^{74} - Sm^{148}	-70.0	*5*	"
2Se^{76} - Sm^{152}	-81.4	*6*	53H58
2Se^{77} - Sm^{154}	-81.8	*3*	54H4
2Se^{77} - Gd^{154}	-81.0	*2*	"
2Se^{78} - Gd^{156}	-87.5	*2*	53H58
2Se^{80} - Gd^{160}	-94.3	*2*	54H4
2Se^{80} - Dy^{160}	-91.0	*8*	"
2Se^{82} - Dy^{164}	-95.2	*8*	"
2Se^{82} - Er^{164}	-96.5	*4*	"
(Se^{79} - Se^{78})/(Se^{80}-Se^{78})	0.50081	*10*	53H50
2Br^{79} - Gd^{158}	-86.6	*2*	54H4
Br^{79}/Br^{81}	0.975307	*5*	53H51
2Br^{81} - Dy^{162}	-92.9	*5*	54H4
2Rb^{85} - Er^{170}	-111.7	*8*	"
2Sr^{88} - Hf^{176}	-128.7	*6*	"
2Y^{89} - Hf^{178}	-131.6	*6*	54H4
2Zr^{90} - Hf^{180}	-137.1	*3*	"
2Zr^{91} - W^{182}	-135.5	*3*	"
2Mo^{95} - Os^{190}	-146.0	*4*	"
3Ba^{138} - 2Pb^{207}	-233.8	*8*	"

MASS DIFFERENCES AND RATIOS continued

	Value		Ref.
Ce^{140} - 2Ge^{70}	+56.8	*6*	53H58
Pr^{141} - 3Ti^{47}	+50.9	*3*	"
Nd^{144} - 3Ti^{48}	+66.7	*3*	"
Nd^{144} - 2Ge^{72}	+66.3	*2*	"
Nd^{146} - 2Ge^{73}	+65.8	*4*	54H4
Nd^{148} - 2Ge^{74}	+74.8	*2*	"
Nd^{148} - 2Se^{74}	+72.3	*4*	"
Nd^{150} - 3Ti^{50}	+85.2	*5*	53H58
Nd^{150} - 2As^{75}	+77.4	*4*	54H4
Sm^{144} - 2Ge^{72}	+66.9	*8*	"
Sm^{148} - 2Ge^{74}	+71.9	*4*	"
Sm^{148} - 2Se^{74}	+70.0	*5*	"
Sm^{150} - 2As^{75}	+72.5	*8*	"
Sm^{152} - 2Ge^{76}	+76.2	*2*	53H58
Sm^{152} - 2Se^{76}	+81.4	*6*	"
Sm^{154} - 2Se^{77}	+81.8	*3*	54H4
Gd^{154} - 2Se^{77}	+81.0	*2*	"
Gd^{156} - 3Cr^{52}	+100.4	*4*	53H58
Gd^{156} - 2Se^{78}	+87.5	*2*	"
Gd^{158} - 2Br^{79}	+86.6	*2*	54H4
Gd^{160} - 2Se^{80}	+94.3	*2*	"
Dy^{160} - 2Se^{80}	+91.0	*8*	"
Dy^{162} - 2Br^{81}	+92.9	*5*	"
Dy^{164} - 2Se^{82}	+95.2	*8*	"
Ho^{165} - 3Mn^{55}	+84.8	*8*	"
Er^{164} - 2Se^{82}	+96.5	*4*	"
Er^{168} - 3Fe^{56}	+126.0	*3*	"
Er^{170} - 2Rb^{85}	+111.7	*8*	"
Hf^{176} - 2Sr^{88}	+128.7	*6*	"

MASS DIFFERENCES AND RATIOS continued

	Value		Ref.
$Hf^{178} - 2Y^{89}$	+131.6	6	54H4
$Hf^{180} - 2Zr^{90}$	+137.1	3	"
$W^{182} - 2Zr^{91}$	+135.5	3	"
$Os^{190} - 2Mo^{95}$	+146.0	4	"
$Pb^{207} - 3Ga^{69}$	+196.6	6	53H58
$2Pb^{207} - 3Ba^{138}$	+233.8	8	54H4

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